# Railway Mechanical Engineer

**Founded in 1832 as the American Rail-Road Journal**
*With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office*

## January, 1937

*Volume 111* *No. 1*

**Locomotives:**

Union Pacific High-Speed Freight Locomotive.... 1
Failures of Locomotive Parts..... 16

**General:**

Necessity for Scientific Research..... 7
Four New Zephyrs for the Burlington..... 8
Operating Experience with the New Haven Comet 20

**Editorials:**

Importance of Research..... 26
Mechanical Supervisors and Public Opinion..... 26
Pertinent Suggestions on Car Repair Billing..... 27
New Books ..... 28

**The Reader's Page:**

"Old Fogey" Gets After Williams..... 29
If I Could Build My Own Roundhouse..... 29

**Gleanings from the Editor's Mail** ..... 30

**Car Foremen and Inspectors:**

Gaging Cast Iron Wheels..... 31
Car Foremen Have Troubles Too (A Walt Wyre Story) ..... 32
Respirator Hood without Vision Glass..... 35
Lubrication Correction ..... 36
Perfection Cotter Lock and Guard..... 36
Armco Galvanized Paintgrip Sheets..... 37
Low-Capacity Air Regulator..... 37
Reseating Tool ..... 38

**Back Shop and Enginehouse:**

Interesting Method for Laying Out Shoes and Wedges ..... 39
Denver Shop Jigs and Devices..... 41
Addition to Murex Coated Electrodes..... 43
Electric Hydraulic Riveter..... 44
All-Welded Drop-Pit Table..... 44
Improved Geist Roller Type Cutter..... 45

**News**..... 46

**Index to Advertisers**.....(Adv. Sec.) 44

Published on the second day of each month

**Simmons-Boardman Publishing Corporation**

1309 Noble street, Philadelphia, Pa. Editorial and Executive Offices, 30 Church street, New York, and 105 West Adams street, Chicago. Branch offices: Terminal Tower, Cleveland; 1081 National Press building, Washington.

SAMUEL O. DUNN, *Chairman of Board*
*Chicago*
HENRY LEE, *President*
*New York*
LUCIUS B. SHERMAN, *Vice-Pres.*
*Chicago*
CECIL R. MILLS, *Vice-Pres.*
*New York*
ROY V. WRIGHT, *Vice-Pres. and Sec.*
*New York*
FREDERICK H. THOMPSON, *Vice-Pres.*
*Cleveland, Ohio*
ELMER T. HOWSON, *Vice-Pres.*
*Chicago*
F. C. KOCH, *Vice-Pres.*
*New York*
JOHN T. DEMOTT, *Treas.*
*New York*

Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States, U. S. possessions and Canada: 1 year, $3; 2 years, $5. Foreign countries: 1 year, $4; 2 years, $7. Address H. E. McCandless, circulation manager, 30 Church street, New York.

*The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.*

**Roy V. Wright**
Editor, New York

**C. B. Peck**
Managing Editor, New York

**E. L. Woodward**
Western Editor, Chicago

**H. C. Wilcox**
Associate Editor, New York

**R. C. Augur**
Associate Editor, New York

**Robert E. Thayer**
Business Manager, New York

# Greater Strength and Shock-Resistance

Modern locomotives, thanks to improved design and improved materials, are capable of developing from 25 to 35% greater horsepower capacity without increased driving wheel loads and within all operating requirements. » » » Agathon Alloy Steels provide the greater strength and shock-resistance that permit lighter weight forgings, yet prolong service life and reduce maintenance. » » » Agathon Staybolts have higher tensile strength to withstand the higher boiler pressures and reduce staybolt costs. » » » Toncan Iron for fireboxes, Agathon Nickel Iron for case hardened parts, Republic Double Strength Steel for lightness in streamlining — for every locomotive part there is a Republic Iron or Steel specially developed to meet the specific need. » » » Our metallurgists are at your call. Address Department RG. » » » » » » » » » » »

**Republic Steel**
**CORPORATION**
ALLOY STEEL DIVISION, MASSILLON, OHIO
GENERAL OFFICES: CLEVELAND, OHIO

REPUBLIC STEEL

The Union Pacific 4-6-6-4 freight locomotive

**Union Pacific**

# High-Speed Freight Locomotive

**American builds 4-6-6-4 type which weighs 566,000 lb. and develops 97,400 lb. tractive force—Front frame construction and articulation incorporate unusual features**

FIFTEEN single-expansion articulated freight locomotives were delivered to the Union Pacific by the American Locomotive Company during the late summer and early fall. These locomotives, which are of the 4-6-6-4 type, develop a starting tractive force of 97,400 lb. They have a total engine weight of 566,000 lb., of which 386,000 lb. is on the drivers. The driving wheels are 69 in. in diameter and the four cylinders are 22 in. by 32 in. The boilers, which carry a working pressure of 255 lb., have a combined heating surface of 7,031 sq. ft. and have a grate area of 108.2 sq. ft.

### The Boiler

The boiler is conical in form, with an inside diameter at the first course of 96 11/16 in. and an outside diameter at the third course of 102 in. The barrel courses are of silico-manganese steel. The firebox is of larger size than is indicated by the grate area. A Gaines arch is installed with a brick wall across the firebox 5 ft. 9 in. back of the front throat sheet, thus adding to the volume of the combustion chamber which extends 86 in. from the throat sheet into the barrel of the boiler. There are five 4-in. arch tubes. The firebox is designed with a horizontal mud ring and fuel is burned on Firebar grates, fed by a Standard Type BK stoker.

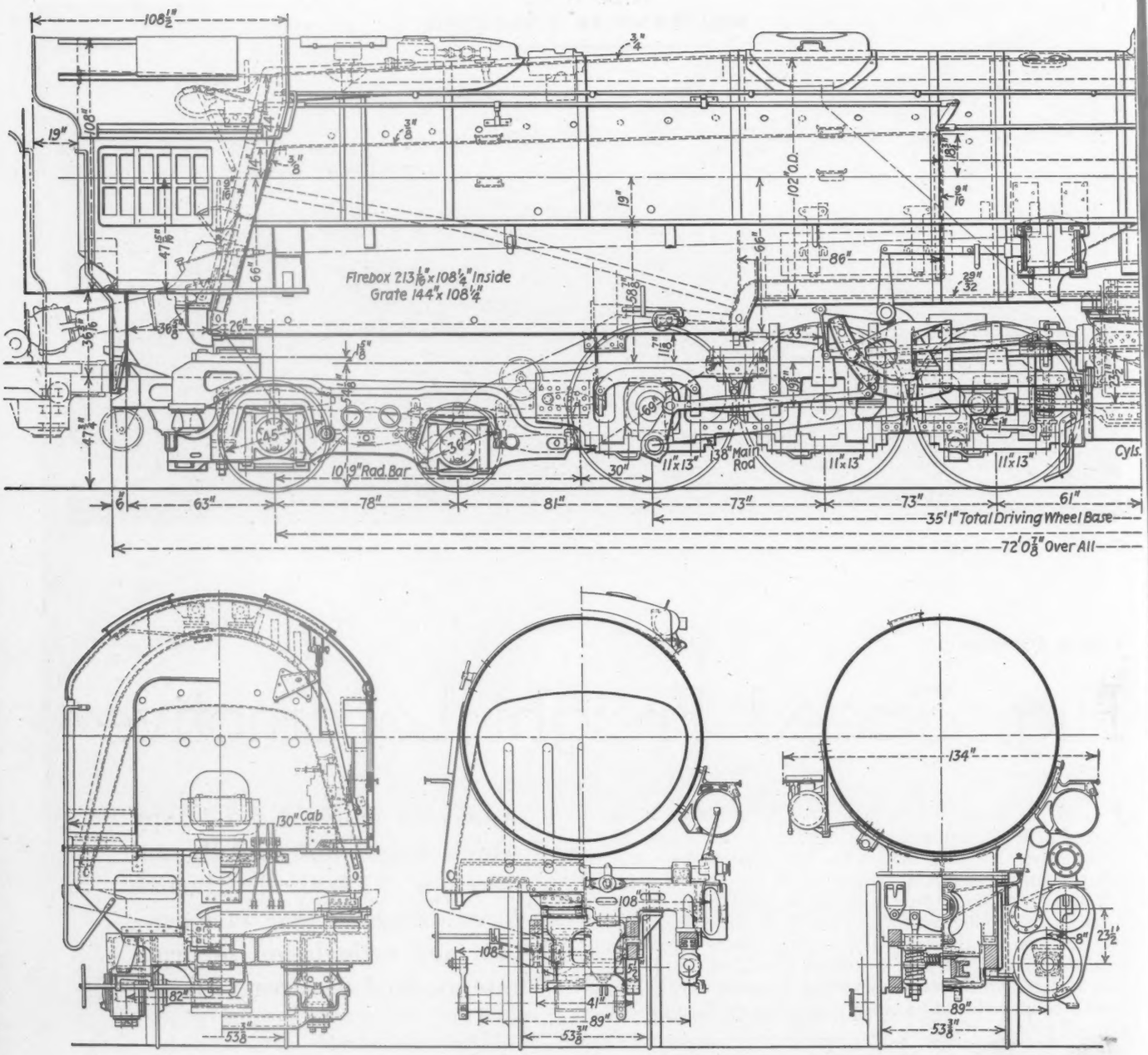
Owing to their size the side and crown sheets are separate and are joined by welding. The inside throat sheet and combustion chamber are also welded into the crown and side sheets. In addition to the Flannery flexible staybolts across the top corners of the side sheets flexible radial stays are applied on the four outside rows on each side of the firebox and combustion chamber, and the adjoining top three rows of staybolts are also flexible. Both the rigid and flexible staybolts, as well as the flexible radial stays, are of Lewis iron. The tapered-end radial stays are of special Ulster iron.

Seal welding is employed on both the inside and outside sheets at the mud-ring corners and at the junctions of the longitudinal and circumferential barrel-course joints, according to the builder's practice. The turret dry pipes extending back from the dome are welded into the turret flange of the roof sheet, and the clamps securing the pipe inside the boiler are welded to the clamp supports, thus providing a permanent installation.

The tube sheets are laid out for the type A superheater. The header is fitted for the American type front-end throttle. Ten of the locomotives are fitted with Worthington No. 6-SA feedwater heaters. The remaining five have Sellers Type S non-lifting exhaust steam injectors.

### The Frame Structure

The frames are of the cast-steel bar type. Those of the rear unit are joined at the rear to the cradle casting



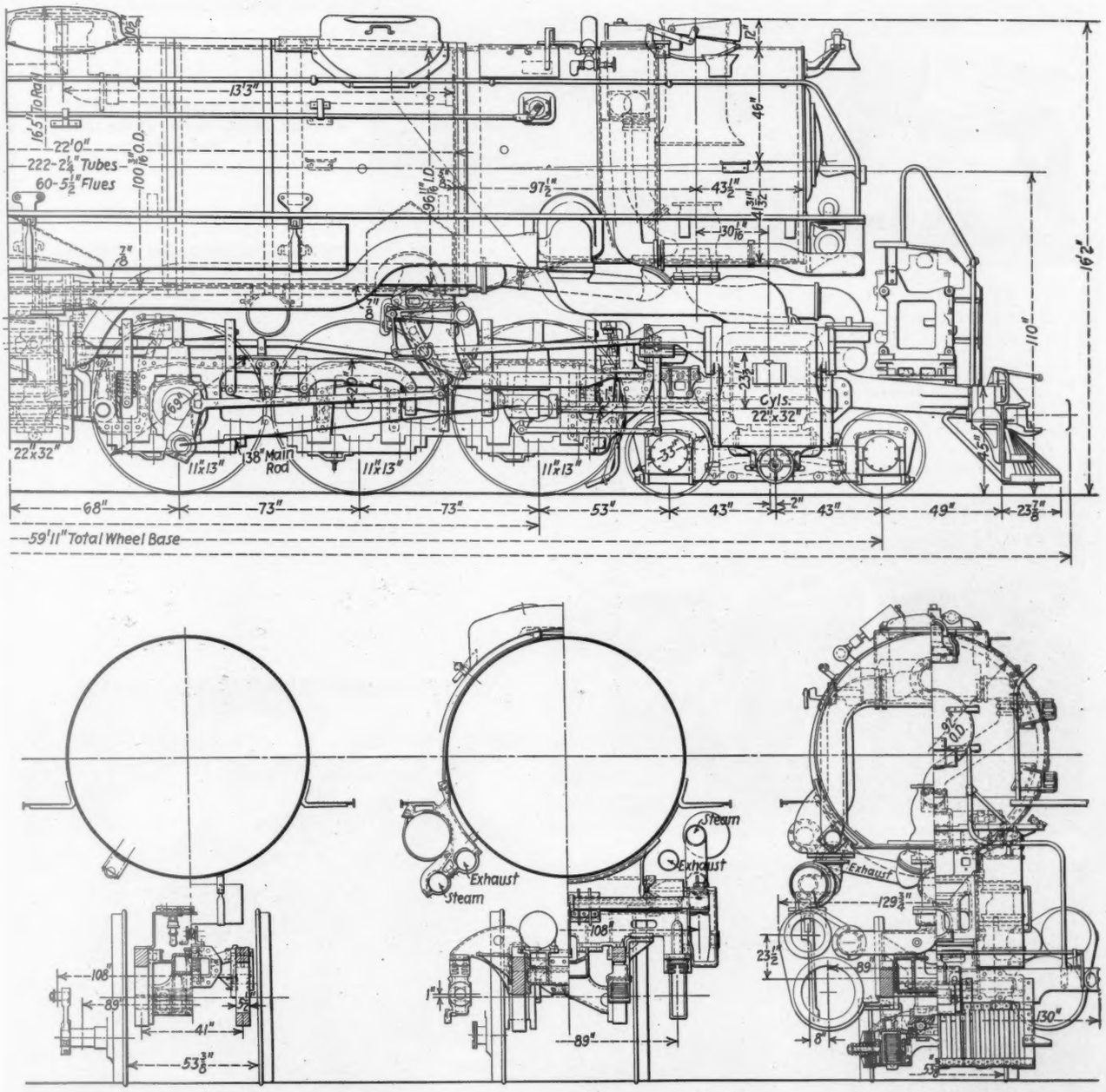

**Cross-sections and elevation of the Union Pacific 4-6-6-4**

and at the front end to the combined cylinder-saddle and articulation casting. The usual type of cross-bracing is employed.

On the front unit, which has no rigid attachment to the boiler, a unique system of bracing and torsional stiffening has been applied. The front ends of these frames are bolted and keyed to a combined cylinder-saddle and front deck casting. Bolting pads are provided on the sides of this casting for the cylinders. A box section of this casting extends back from the saddle portion approximately to the front pedestal. The rear end of this casting terminates in a transverse vertical bolting flange, to which is bolted a long box-section casting which extends back between the frames. From this project suitable bolting pads for attachment to the inside faces of the vertical members of the frames. At the articulation casting between the rear ends of the frames transverse bolting flanges again provide for a rigid connection between the two castings. Pads are provided on top of the backbone casting for attachment of the single boiler support.

The articulation hinge is pivoted horizontally in the rear end of the front articulation casting. It is ball connected to the vertical hinge pin in the rear engine unit. This provides for free adjustment of the two engines to vertical track curvature, with the front boiler support as the pivot about which the vertical angular movement of the front frame system takes place.

The pivoted hinge is cast with a vertical bell crank arm to which is attached a stabilizer to prevent possible synchronous oscillations of the front frame system. The stabilizer consists of a wide horizontal bar extending forward along the center line of the front engine. This bar passes between horizontal white fibre friction surfaces which exert a predetermined resistance to the longitudinal movement of the bar under load of three inner coils from Class G springs and thus prevent the free oscillation of the articulation tongue about its







type single-expansion locomotive for freight service

horizontal pivot in the front frame system. Further resistance to the setting-up of a vertical rocking motion in the front frame system is provided by a snubbing device in the engine truck.

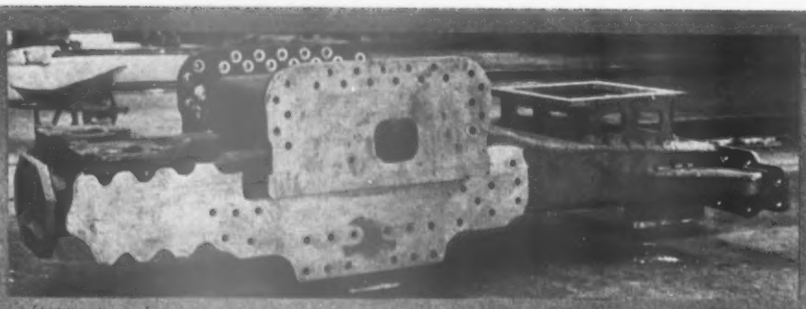
The boiler is rigidly attached to the rear cylinder saddle, and the firebox is supported by expansion shoes at each of the four corners. All of the expansion shoes are completely encased so that they are dirt and oil tight.

An unusual detail of the frame construction is the fitting of the pedestal caps metal to metal against the frames. The pedestal toes are extra heavy.

## Running Gear

The driving wheels are the Alco Boxpok type, and the main drivers, only, are cross-counterbalanced on each unit. The driving axles are fitted with crown bearing boxes and with Franklin grease collars. The front pair of drivers in each unit is provided with the Alco lateral cushioning device. The front and rear spring hangers on the front driving-wheel system have coil snubber springs. Similar springs are also applied to the front driving spring hangers of the rear unit and on the rear trailer spring hangers.

The locomotives have Alco engine trucks with lateral resistance of the geared roller type. These are built with a low initial resistance gradually building up to a higher resistance which becomes constant after about 1 in. of lateral movement. The vertical damping device which is built into each side of the engine truck consists of fibre discs mounted on a horizontal spindle at each side of the truck frame. Between the fibre discs are two rotating metal plates, projecting from each of which is a tongue by which it is connected to the end of the bolster, by linkage. The links are on opposite sides of the spindle about which the plates rotate. Any



Left: The front deck and cylinder-saddle casting of the forward unit

Right: The backbone casting of the forward unit

Above: The articulation casting at the rear end of the front frame system

Above: The front frame assembly with the deck backbone and articulation casting in place—Left: The articulation hinge at the rear end of the front unit showing the snubber connection

vertical movement of the bolster with respect to the truck frame, therefore, causes the discs to rotate in opposite directions, a movement which is restrained by the adjustable friction load on the discs imposed by a coil spring on the spindle.

The trailer truck is of the Commonwealth four-wheel type. The centering device on this truck is designed to produce an initial resistance of 8 per cent which builds up to a constant resistance of 15 per cent. Both engine and trailer trucks are fitted with SKF roller-bearing journal boxes, those on the front truck being of the inside type and those on the rear truck of the outside type.

The pistons are of solid rolled steel in Z-section fitted with the Locomotive Finished Material Company's combined bull ring and packing rings. The valve chambers are fitted with Hunt-Spiller bushings and the valves have Hunt-Spiller duplex packing rings. Paxton-Mitchell packing is used on both valve stems and piston rods.

The guides and crossheads are of the multiple-ledge type. The piston rods and the side and main rods are carbon steel, normalized and tempered. The same material is also used for the axles and crank pins.

The locomotives are fitted with Walschaert valve motion with the link blocks of each unit at the bottom of the links in forward motion. The reverse gear is a Franklin type E with 12 in. cylinder. It is directly connected to the reverse shaft of the rear unit and drives the reverse shaft of the forward unit through a reach rod extending forward along the center line of the locomotive with a crosshead and universal joint in the rear cylinder saddle.

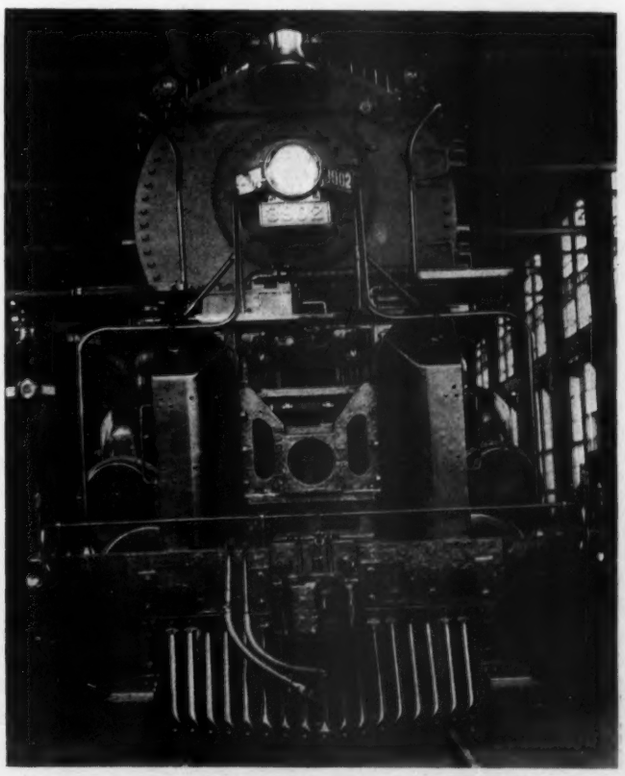
Alloy-steel bolts have been extensively used in the construction of these locomotives. Nickel steel is the material for all taper frame bolts, for boiler studs, cylinder-head studs, cylinder-to-frame bolts, and all steampipe bolts. The guide bolts, cylinder-saddle bolts, boiler-bearing bolts, the bolts in the front frame bracing

**General Dimensions, Weights and Proportions of the Union Pacific, 4-6-6-4 Type Locomotive**

| | |
|---|---|
| Railroad | Union Pacific |
| Builder | American Locomotive Co. |
| Type of locomotive | 4-6-6-4 |
| Road number | 3902 |
| Date built | August, 1936 |
| **Dimensions** | |
| Height to top of stack, ft. and in. | 16—2 |
| Height to center of boiler, ft. and in. | 11—0 |
| Width overall, in. | 11—2 |
| Cylinder centers, in. | 89 |
| **Weights in working order, lb.:** | |
| On drivers | 386,000 |
| On front truck | 74,500 |
| On trailing truck | 105,500 |
| Total engine | 566,000 |
| Tender | 310,000 |
| **Wheel bases, ft. and in.:** | |
| Driving | 12—2 |
| | 12—2 |
| Rigid | 12—2 |
| Engine, total | 59—11 |
| Engine and tender, total | 97—10½ |
| **Wheels, diameter outside tires, in.:** | |
| Driving | 69 |
| Front truck | 33 |
| Trailing truck | Front, 36; Rear, 45 |
| **Engine:** | |
| Cylinders, number, diameter and stroke, in. | 4-22 x 32 |
| Valve gear, type | Walschaert |
| Maximum travel, in. | 7½ |
| Steam lap, in. | 1⅜ |
| Exhaust lap, in. | ⅛ |
| Lead, in. | ¼ |
| **Boiler:** | |
| Type | Conical |
| Steam pressure, lb. per sq. in. | 255 |
| Diameter, first ring, inside, in. | 96 11/16 |
| Diameter, largest, outside, in. | 102 |
| Firebox, length, in. | 213 1/16 |
| Firebox, width, in. | 108¼ |
| Height mud ring to crown sheet, back, in. | 80 |
| Height mud ring to crown sheet, front, in. | 84¼ |
| Combustion chamber length, in. | 90 |
| Tubes, number and diameter, in. | 222—2¼ |
| Flues, number and diameter, in. | 60—5½ |
| Length over tube sheets, ft. and in. | 22—0 |
| Net gas area through tubes and flues, sq. ft. | 10.55 |
| Fuel | Soft coal |
| Stoker | Standard Type BK |
| Grate type | Firebar |
| Grate area, sq. ft. | 108.2 |
| **Heating surfaces, sq. ft.:** | |
| Firebox and comb. chamber | 548 |
| Arch tubes | 77 |
| Firebox, total | 625 |
| Tubes and flues | 4,756 |
| Evaporative, total | 5,381 |
| Superheating (type) | 1,650 |
| Combined evap. and superheat. | 7,031 |
| **Tender:** | |
| Style or type | Semi-Vanderbilt |
| Water capacity, U. S. gal. | 18,350 |
| Fuel capacity, tons | 22 |
| Trucks | 12-wheel |
| **General data, estimated:** | |
| Rated tractive force, engine, 85 per cent, lb. | 97,400 |
| **Weight proportions** | |
| Weight on drivers ÷ weight, engine, per cent | 68.2 |
| Weight on drivers ÷ tractive force | 3.96 |
| Weight of engine ÷ comb. heat. surface | 80.6 |
| **Boiler proportions:** | |
| Firebox heat. surface, per cent comb. heat. surface | 8.9 |
| Tube-flue heat. surface, per cent comb. heat. surface | 67.6 |
| Superheat. surface per cent comb. heat. surface | 23.5 |
| Firebox heat. surface ÷ grate area | 5.78 |
| Tube-flue heat. surface ÷ grate area | 43.9 |
| Superheat. surface ÷ grate area | 15.3 |
| Comb. heat. surface ÷ grate area | 64.9 |
| Gas area, tubes-flues ÷ grate area, per cent | 10.3 |
| Tractive force ÷ grate area | 906.0 |
| Tractive force ÷ comb. heat. surface | 13.8 |
| Tractive force × dia. drivers ÷ comb. heat. surface | 955.8 |

**A Comparison of Union Pacific 4-6-6-4 and 4-12-2 Type Freight Locomotives**

| Builder | American | American |
|---|---|---|
| Rated tractive force, lb. | 97,400 | 96,650 |
| Weight on drivers, lb. | 386,000 | 355,000 |
| Total engine weight, lb. | 566,000 | 495,000 |
| Cylinders, diameter and stroke, in. | 4–22 × 32 | 2–27 × 32<br>1–27 × 31 |
| Boiler pressure, lb. | 255 | 220 |
| Grate area, sq. ft. | 108.2 | 108.25 |
| Total evaporative heating surface, sq. ft. | 5,381 | 5,853 |
| Superheating surface, sq. ft. | 1,650 | 2,560 |



**The air compressors are located on the front deck—The hot-water pump of the feedwater heater is mounted on the smokebox front**

## Partial List of Specialties on the Union Pacific 4-6-6-4 Type Locomotive

| | |
|---|---|
| Frame cradle | General Steel Castings Corp., Eddystone, Pa. |
| Driving wheels, Boxpok | General Steel Castings Corp., Eddystone, Pa. |
| Engine and trailer truck wheels, rolled steel | Standard Steel Works Co., Burnham, Pa. |
| Tires, driving and back trailing | Latrobe Electric Steel Co., Latrobe, Pa. |
| Engine, trailer and tender-truck box bearings | SKF Industries, Philadelphia, Pa. |
| Brake equipment, 8-ET, with K-8PA engineer's brake pedestal | New York Air Brake Co., New York |
| Engine truck, cast-steel inside bearing type | American Locomotive Co., New York |
| Trailing truck, Delta | General Steel Castings Corp., Eddystone, Pa. |
| Radial buffer, type E-2 | Franklin Railway Supply Co., Inc., New York |
| Reverse gear, Ragonnet type E 12-in. cylinder | Franklin Railway Supply Co., Inc., New York |
| Stoker, latest BK type | Standard Stoker Co., New York |
| Stoker gages, Duplex | Consolidated Ashcroft-Hancock Co., Inc., Bridgeport, Conn. |
| Grates, Firebar type | Waugh Equipment Co., New York |
| Fire brick | American Arch Co., Inc., New York |
| Fire door, Butterfly | Franklin Railway Supply Co., Inc., New York |
| Superheater, Type A | Superheater Company, New York |
| Smokebox hinge | Okadee Co., Chicago |
| Feedwater heater, type 6-SA (on 10 engines) | Worthington Pump & Machinery Corp., Harrison, N. J. |
| Exhaust steam injector, L. S., and type S non-lifting injector, R. S. (on five engines) | Wm. Sellers & Co., Inc., Philadelphia, Pa. |
| Injector, type HW Simplex, R. S. (on 10 engines) | Nathan Manufacturing Co., New York |
| Injector checks | Consolidated Ashcroft-Hancock Co., Bridgeport, Conn. |
| Cylinder bushings, Gun iron | Hunt-Spiller Mfg. Corporation, South Boston, Mass. |
| Cylinder cocks, steam operated | Prime Manufacturing Co., Milwaukee, Wis. |
| Piston valve bushings, Gun iron | Hunt-Spiller Mfg. Corporation, South Boston, Mass. |
| Lubricators, front engine, Model A (2) | Detroit Lubricator Co., Detroit, Mich. |
| Lubricators, back engine, DV-4 (2) | Nathan Manufacturing Co., New York |
| Lubrication—Valve gear, brake, hangers, throttle rigging, bell, smokestack hood, engine truck and front exhaust pipe joints | Alemite Corp., Chicago |
| Eccentric rod grease cups | Prime Manufacturing Co., Milwaukee, Wis. |
| Rod lubrication fittings | Prime Manufacturing Co., Milwaukee, Wis. |
| Flange oiler on front wheel of front engine | Detroit Lubricator Co., Detroit, Mich. |
| Flexible connections, between front and back engine | Barco Manufacturing Co., Chicago |
| Flexible connections between engine and tender | Franklin Railway Supply Co., New York |
| Steam heat | Vapor Car Heating Co., Inc., Chicago |
| Feed hose strainers: R. S. 10 engines | T-Z Railway Equipment Co., Chicago |
| L. S. 10 engines | Worthington Pump & Machinery Corp., Harrison, N. J. |
| R. and L. 5 engines | Wm. Sellers & Co., Inc., Philadelphia, Pa. |
| Lagging, standard magnesia | Johns-Manville Corporation, New York |
| Steam pipe covering, Insutape | Union Asbestos & Rubber Co., Chicago |
| Combined bull ring and packing rings | Locomotive Finished Material Co., Atchison, Kan. |
| Piston-rod and valve-stem packing | Paxton-Mitchell Co., Omaha, Neb. |
| Steam-pipe slip-joint packing | Paxton-Mitchell Co., Omaha, Neb. |
| Stoker and blower throttle valves | Consolidated Ashcroft-Hancock Co., Bridgeport, Conn. |
| All other valves | Lunkenheimer Co., Cincinnati, Ohio |
| Blow-off cocks and sludge remover | Wilson Engineering Corp., Chicago |
| Water gage | Wiltbonco Mfg. Co., Boston, Mass. |
| Water-gage glass, MacBeth reflex | MacBeth-Evans Glass Co., Charleroi, Pa. |
| Gage cocks | Prime Manufacturing Co., Milwaukee, Wis. |
| Safety valves and steam gages | Consolidated Ashcroft-Hancock Co., Bridgeport, Conn. |
| Sanders, ALE 101 type | Viloco Railway Equipment Co., Chicago |
| Throttle | American Throttle Co., Inc., New York |
| Whistle, chime | Consolidated Ashcroft-Hancock Co., Bridgeport, Conn. |
| Engineer's cab seat | Gustin-Bacon Mfg. Co., Kansas City, Mo. |
| Cab clear-vision window | Prime Manufacturing Co., Milwaukee, Wis. |
| Cab windshield wings | Prime Manufacturing Co., Milwaukee, Wis. |
| Handrail posts, two-piece type | American Locomotive Co., New York |
| Headlight, classification, cab lamps and headlight equipment | Pyle-National Company, Chicago |
| Train number indicator | Adams & Westlake Co., Elkhart, Ind. |

system, pedestal-cap and engine-truck pedestal bolts, among others, are of chrome-nickel steel.

### Steam Pipes and Lubrication

The steam pipes for both front and rear cylinders on each side are connected to a single secondary header outside the smokebox. To this header the front steam pipe is connected with a vertical ball joint. At the steam chest end it is fitted with a combined ball and slip joint. The relatively long steam pipe to the rear cylinders is fitted with a balanced slip joint at the steamchest connection. The cast-steel slip pipe is ported and packed on both sides of the ports with Unarco asbestos rings.

Each rear cylinder is provided with an independent

The back boiler head—The exhaust-steam injector control is shown at the extreme left

The geared lateral motion center plate of the engine truck—The friction type snubber is shown in the left foreground

exhaust pipe which extends forward along the boiler to one side of a Y-fitting at the nozzle base. The exhaust pipe from the front cylinders has the usual vertical ball connections both at the front (cylinder) and rear (exhaust nozzle) ends, with a ring-packed slip joint. The steam from both front and rear cylinders exhausts into a common exhaust nozzle chamber from which a single pipe connection leads to the feedwater heater mounted inside the front-end contour just back of the stack, or to the exhaust-steam injector mounted under the cab on the left side.

The front engines are fitted with Detroit force-feed lubricators with feeds leading to the cylinders, valves and guides and to the steam-pipe joints. Provision has also been made for oiling the flanges of the front wheels should this be found desirable. The rear engine unit is fitted with a Nathan force-feed lubricator with leads to the cylinders, valves and guides and to the steam-pipe joint.

The cabs on these locomotives are insulated with 2-in. paper-covered fibre glass, except for a wood lining on the roof. The fibre glass is also applied under the firing deck.

The interior of the cab presents an unusually neat appearance. All cab piping, as well as the valves, is concealed underneath the boiler jacket. The air brakes are New York No. 8ET with the brake valves pedestal mounted. Windshields at the cab side windows are Prime non-shatterable glass.

### The Tenders

The tenders have cast-steel water-bottom underframes with tanks of semi-Vanderbilt form. They are carried on two Buckeye six-wheel trucks fitted with SKF roller bearings. The engine-tender connections are Unit safety drawbars with the Franklin Type E radial buffer. At the rear end the tenders are fitted with Miner A-78-XB draft gears.

**Necessity for**

# Scientific Research

**Many important questions relating to commonplace problems remain unanswered**

COL. J. T. LOREE, vice-president and general manager of the Delaware & Hudson, gave an address at a recent meeting of the New England Railroad Club,* which proved to be unusually thought-provoking. This article covers those parts of special interest to mechanical-department readers.

In 1825, Nicholas Wood wrote, "The present state of commerce requires that goods should be conveyed from place to place with the utmost rapidity, and perhaps we owe no small portion of mercantile prosperity to our facility of dispatch," and in 1934 Alexander Gordon of London wrote, "Expeditious locomotion, to the commercial world more particularly in every mercantile transaction, is equivalent to capital and such is the vast importance of economy of time, here, that no extra expense is considered as too great to accomplish the utmost speeds. . . . Nay, we have lately seen the speed of eight miles increased to nine, though purchased at an addition of one-third of the original outlay and again accelerated to ten, though it could only be effected by doubling the whole costs."

### Transportation Costs

But what affects the cost of the transportation furnished? First, the item of wages—usually not too high as a base, but if paid for non-productive or careless work or as arbitraries, excessive to that extent. Second, service of funded debt, in the form of interest payments and rentals. Third, the ever growing taxes both direct and indirect. Fourth, both state and federal commissions' requirements and regulations. And lastly, the cost of acquisition and maintenance of the physical units.

If you will consider for a moment, are you not rather startled to find how little basically we really know about any of these items, except most generally. May I enlarge somewhat on the last two. Much blame is cast upon the commissions as to the fixation of rates and the length of time it takes to get a change thereon. Would you, however, not find it hard yourselves to follow the logic of advancing rates, when the price of all other commodities was decreasing and then reducing rates when commodity prices were advancing.

### Washing Boilers

Or again, the Bureau of Boiler Inspection of the Interstate Commerce Commission has ruled that boilers shall be washed out once a month. This is an item of considerable expense, directly as to the work and material involved, indirectly as to the loss of potential usefulness of the engine. The purpose, as you know, is to prevent the accumulation of scale in the boiler which decreases its efficiency and if allowed to exceed a certain amount results in a possibly dangerous condition. The real facts are that in locations where the water is heavily charged with alkalines, engines cannot possibly run 30 days without washing even with treated water, whereas in other locations where water is free from alkalis, scale will not accumulate in any appreciable quantity under some 90 days. In other words, fundamentally the chemical analysis of the water indicates the condition, but have the railroads ever presented to the Bureau a suggestion of a water analysis upon which a rational requirement might be issued?

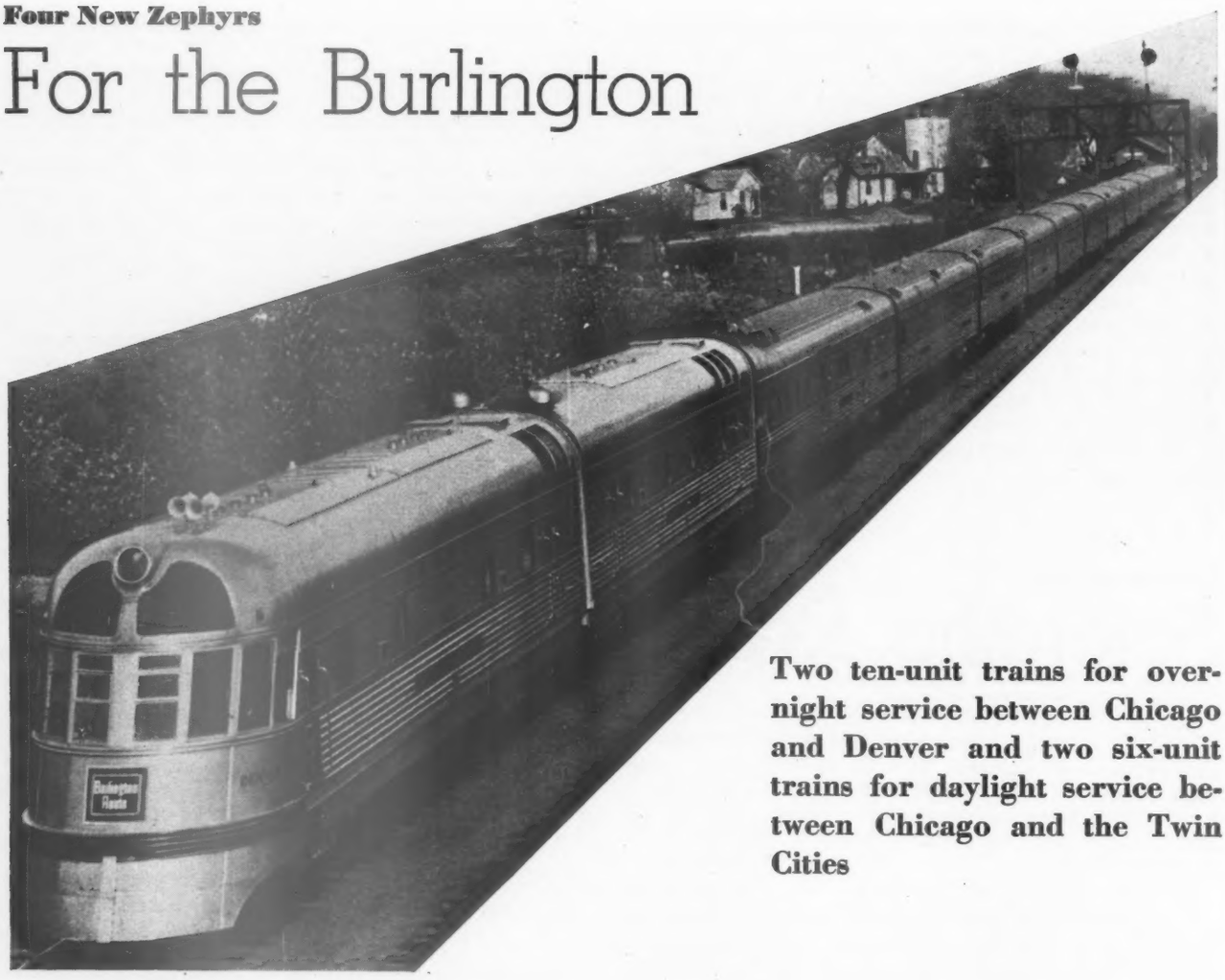
Consider our knowledge in the field of physical units. We draw cars by locomotives over rails. These locomotives are actuated by steam, electricity or oil and basically we know almost nothing about these agents. What is steam? Water subjected to heat above a certain point separates and gasifies. In this process it expands. We confine this expanding fluid in a cylinder which is fitted with a piston which is driven by the force of this expansion, and by a beautiful mechanical device transfers horizontal motion into rotary motion. Now all of this was worked out by Watt and Bolton, Severy, Trevethick and Stephenson, over a hundred years ago. What we really

(*Continued on page 25*)

* October 13, 1936.

**Four New Zephyrs**

# For the Burlington

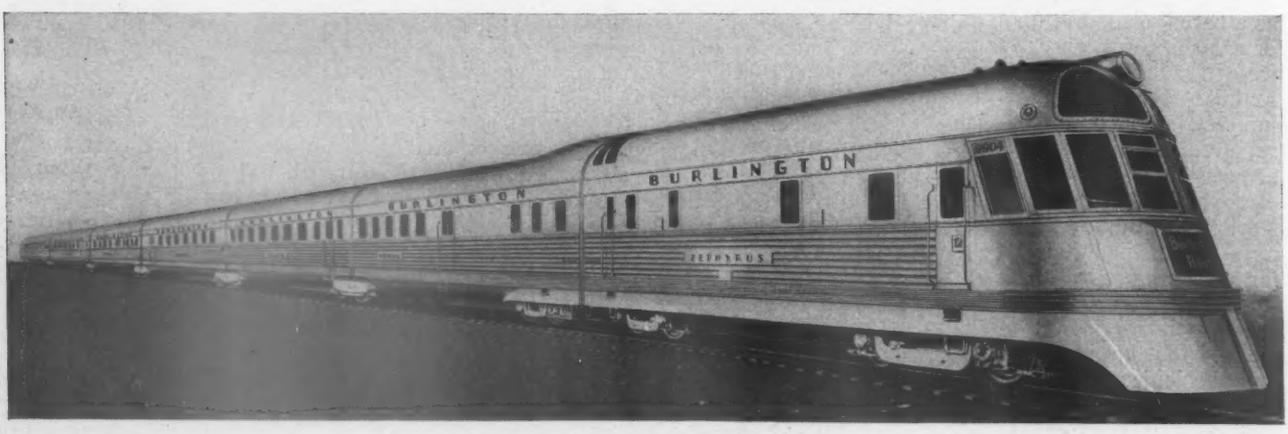


**Two ten-unit trains for overnight service between Chicago and Denver and two six-unit trains for daylight service between Chicago and the Twin Cities**

WITHIN the past two months the Chicago, Burlington & Quincy has placed in service four new light-weight stainless streamlined trains. These trains all of which were built by the Edward G. Budd Manufacturing Co., are hauled by Diesel-electric locomotives built by Electro-Motive Corporation. Two of the trains consist of ten partially articulated body units each. Included in them are four sleeping cars. These trains, known as the Denver Zephyrs, Nos. 9906 and 9907, were placed on regular 16-hour overnight schedules between Chicago and Denver, Colo., on November 7. Each of the other two trains consist of six fully articulated body units and is hauled by a single-unit 1,800 hp. Diesel-electric locomotive.

These trains, No. 9904 and 9905 and known as the Twin Cities Zephyrs, went into daylight service between Chicago and St. Paul, Minn., and Minneapolis on December 18.

Each Denver Zephyr consists of a combination engine-room, mail and baggage car; a combination baggage, crew quarters and cocktail lounge; two coach body units; a diner; three open-section body units; a drawing-room-bedroom-compartment unit, and a combination parlor and observation lounge unit. It provides seats for 100



One of the cocktail lounges with a four-section annex

coach passengers, 93 upper and lower berths, 10 parlor seats, and 104 lounge and dining-room seats, with 31 additional seats in the men's and women's dressing rooms. Each of the Twin City Zephyrs is made up of a combination train-power, baggage and cocktail lounge; two coach bodies; a diner; a parlor car, and a parlor-lounge. It provides seats for 120 coach passengers; 50 passengers in the parlor cars, including 7 in the drawing room, 10 in the observation room and card section of the rear car; 30 in the cocktail lounge, and 32 in the dining room.

### The Denver Zephyrs

The first revenue unit in each of the Denver Zephyrs consists of a two-truck car comprising an auxiliary power unit supplying 220-volt, 60-cycle, three-phase current for operation of lights, bar refrigeration and air-conditioning equipment. The equipment consists of four Diesel-driven generators each with its own control panel. Back of the engine room is a 30-foot railway post office and then a 24-foot baggage space. The second body unit is another two-truck car containing a 23-foot baggage space, sleeping quarters for the dining-car crew of 12 men with a shower room and lockers

One of the coaches of the Twin Cities Zephyrs

and at the rear end a cocktail lounge with a quarter-circle bar at the front.

The next three units are articulated to form a single vehicle. The first and second of these are coaches—the first providing rotating type seats for 64 persons with three-position reclining backs and removable center arm rests. The second provides similar seats for 38 persons. At the forward end of the first of these units are placed ladies and men's rooms and at the rear are two luggage lockers. In the second coach unit are two men's rooms—one a lavatory and the other a toilet. In the rear of the car is a spacious and luxuriously fur-

Observation-lounge of the Denver Zephyr

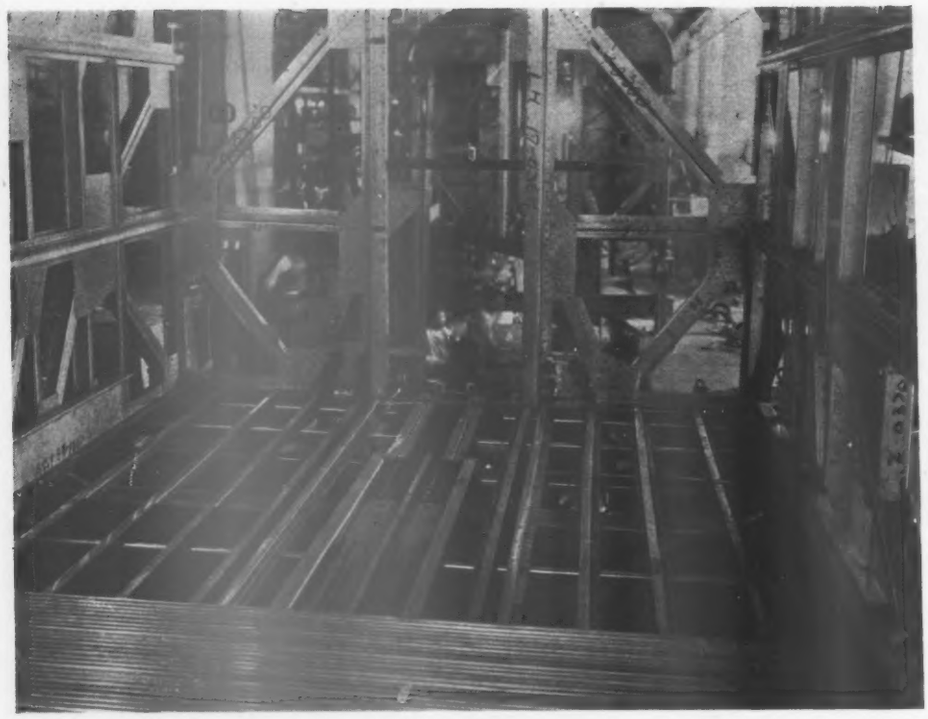
nished ladies lounge and annex. The third unit in this articulated group is a 40-passenger diner with a 23-foot kitchen. The sixth and seventh body units constitute an articulated pair of section sleepers, each with a men's room at the forward end and ladies room at the rear. The eighth body unit is another 12-section sleeper and the ninth contains one drawing room, three compartments and six bedrooms. In each of the sixth and eighth body units are two "tall men" berths which measure 6 ft. 8 in. long. The others are 1½ in. longer and slightly wider than those on conventional trains.

The tenth body unit is a two-truck combination parlor and lounge car with a buffet between the parlor and observation lounge sections.

### The Twin Cities Zephyrs

The two-unit Twin Cities Zephyrs differ principally from the Denver Zephyrs in the absence of facilities for

One of the dining cars



The side and end frame and details of the floor construction

overnight travel. The first body unit contains an engine room with three Diesel generator sets for train lighting and other auxiliary power, a small baggage compartment and a cocktail lounge with bar similar to that in the Denver Zephyrs.

Each of the two coach units contains 30 Heywood-Wakefield transverse double seats. At the forward end of the first coach and at the rear end of the second coach are a men's lavatory on one side of a central passage and a women's on the other, in each case separated from the passenger compartment by a step well and side entrance doors. The fourth unit is a dining car similar in general arrangement to that on the Denver Zephyrs but with a dining room seating 32 passengers. On both trains the dining tables are arranged to seat four persons each, on both sides of the aisle.

The fifth unit is a parlor car with 19 rotating parlor chairs located in the portion of the car to the rear of the side-door step well. At the rear end of this car is a drawing room arranged with no upper berth but furnished with two transverse seats and a longitudinal sofa. Forward of the step well are men's and women's rooms on opposite sides of the car arranged and equipped the same as those in the coaches. The drawing room is provided with a lavatory. The rear unit on these trains accommodates 24 persons in rotating parlor-car seats and has six occasional chairs in the observation lounge at the rear end, with a card playing section between.

### Body Construction

The car sheathing and structure, except the end underframe, needle beams and articulated end sills of all of these trains are stainless steel, known as 18-8. While this material is available in a wide range of physicals, those used in the construction of these cars are either high-tensile (150,000 lb. tensile strength), which is used for those parts where light-weight strength is most important, or low-tensile (100,000 lb. tensile strength), which is used where ductility or special finish is most important. The Shotweld process is generally employed in the fabrication of the stainless steel.

Fundamentally, the roof and under structure (floor stringers and belly side) serve as compression and tension chords of a beam. They are connected by a Pratt truss, modified as necessary for doors and windows. The longitudinal moldings serve to reinforce against localized stresses due to eccentricities. Necessary reinforcements are applied in accordance with determinations made in the analysis of the various components of the structure. In the vicinity of door openings which occur between truck centers the reinforcements are in the form of additional carlines and by flat sheets welded inside the corrugated roof sheets. Reinforcements of this type have proved most efficient in resisting shear at these points.

The end structure is properly analyzed to withstand buffing, traction, vertical and lateral loads that are to be expected in service and as specified by the Railway Mail Service. At the articulating joints the car body is riveted to an extended center plate made of annealed cast steel in which the side bearings are incorporated. The points of connection are amply reinforced to permit a satisfactory riveted joint, and the strength in effect tapered from this heavy casting to the light structure. The design of these end sills is such that the male casting on one car rests in a pocket in the female casting of the adjoining car and the female casting in turn rests in a pocket in the truck center plate. Vertical loads are withstood by the end truss of the car structure. The bending moment due to inherent articulation eccentricity is resisted by the sill casting, which extends into and is attached to a Cromansil needle beam and the stainless-steel center sill, and by a deep vertical beam extending to the roof on either side of the passageway. These vertical beams serve also as antitelescoping members meeting the Railway Mail Service specifications for full strength. The extended attachment of these beams to the roof is designed to withstand the shear developed at the upper ends of the beams.

At non-articulating ends, the under car structure consists of an end underframe made of Cromansil welded into a unit and subsequently stress relieved. The design of this unit is such that it serves as body bolster,

side bearings, draft-gear housing, end sill and center sill back to the stainless-steel center sill. This member is likewise riveted to the reinforced stainless-steel body structure.

The entire exterior is sheathed in stainless steel selected for finish. The combination of dull-finished paneling and bright-finished moldings presents a pleasing appearance which can be maintained by ordinary shop washing. The surface is unpainted except for lettering on letter board and name plates.

The doors throughout this train are so constructed as to fit flush and present a continuation of the body appearance when closed. The rails and the fluted panels and all other moldings which are interrupted at the door opening are applied on the door so that when the doors are closed there is no apparent break in the car contour. The baggage and mail doors are suspended from an overhead track and are guided by a floor track which leads the door from a flush closed position to an open position inside the car body. Passenger doors are double type, hinged on either side. In addition to the vertical split, certain of the doors are split horizontally approximately at the belt rail to permit the train crew to pick up train dispatches.

The interior doors are hinged in such a way that there is no possibility of pinching, although anti-pinch plates are not applied.

Outside passenger doors are fitted with folding steps which, when not in use, are folded into the car body and present an appearance similar to the body proper. A novel feature is a light mounted in the lower riser of these steps which is operated automatically by the trap mechanism. The steps themselves are faced with aluminum Diamondette treads with a nosing of punched and formed stainless steel as a guard against slipping.

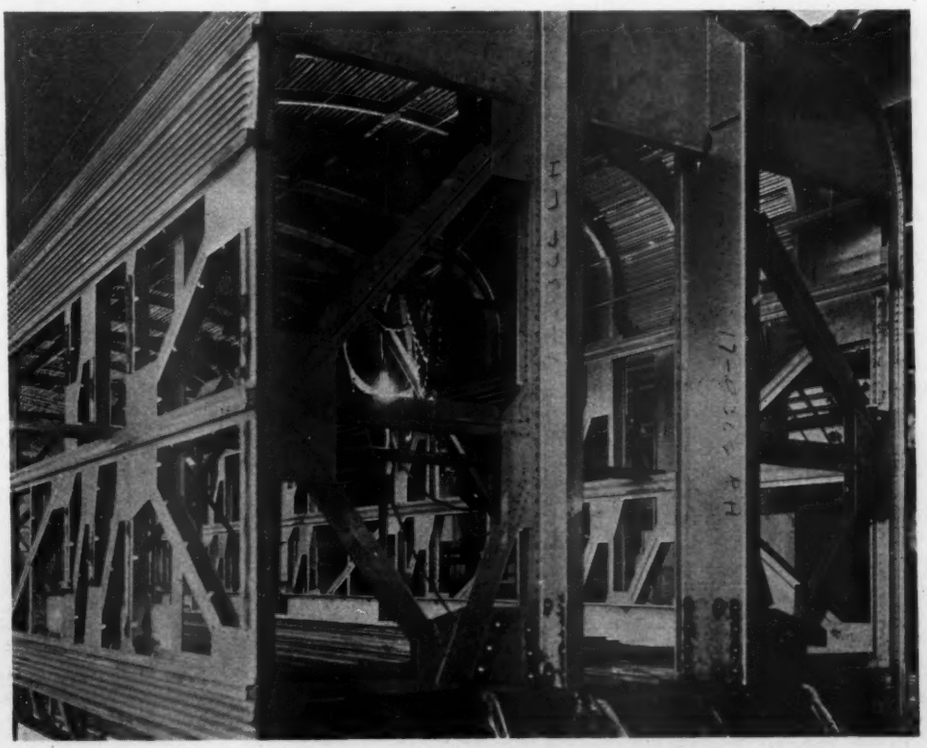
The side windows at passenger seats are of generous size. They are composed of two thicknesses of shatterproof glass with a hermetically sealed, dehydrated air space between them. This dehydrated air space precludes the possibility of condensation on the inner glass when it is subjected to temperature drop. The hermetically sealed air space cannot change its water vapor content, nor can its dust content increase. The double glazing reduced the heat transfer. All sashes are inserted in stainless steel frames which are securely attached to the side frames with stainless steel screws. The glass itself is cushioned from the frames by the generous use of rubber.

The insulation of the passenger cars is Flame-Proofed Dry Zero applied as blankets to fit the voids between the inner and outer walls. The side-wall material is 3 in. thick and the roof and end material is 2 in. thick. The underside of the floor over the trucks is insulated by a corrugated or undulating layer of ½-in. Thermofelt, which is retained and protected on the underside by stainless-steel sheets attached to the floor stringers. Belly side insulation consists of ½-in. Hairinsul faced with Seisal Kraft paper, and the belly hatches are insulated with ½-in. Hairinsul protected with Mulehide. The insulation in the baggage rooms, Railway Post Office and engine-roof sides and roof is Navy type Alfol applied in six layers.

The cars in the Denver Zephyrs are fitted with automatic connectors made by the Ohio Brass Company. These connectors comprise air and steam, 220-volt power lines, telephone, control, and signal circuits. They are mounted beneath the O-B Tight-Lock couplers and the semi-permanent drawbars, which are applied in place of couplers between certain cars. Tight-Lock couplers are placed between the two locomotive units of the Denver Zephyrs, between the locomotives and the first cars of all of the trains and between the first and second cars and the fifth and sixth body units of the Denver Zephyrs. The semi-permanent bolted drawbars are used between the second and third units, the seventh and eighth units, and the ninth and tenth units of these two trains.

### Train Power and Heating

Power for air conditioning, lighting, battery charging, ventilating, blowers, refrigeration, radios, telephones and various accessories, is generated by Diesel-engine gener-



**Details of the end and side-frame construction of an articulated body unit**

Application of the insulation in the roof and sides of one of the cars

ator sets located in the first car of each train. On the Denver Zephyrs there are four of these sets, on the Twin Cities Zephyrs, three. Each set consists of an 85-hp., 6-cyl. Cummins Diesel engine, driving a General-Electric 50-kw., 220-volt, 3-phase, 60-cycle generator.

The power from the generating units is distributed through the train by two three-wire train lines, one supplying the air-conditioning load and the other the lighting. Under normal conditions of operation the train lines are separated and supplied by separate generators, so that no flicker of the lights can be caused by the starting of air-compressor motors. In addition there is a two-wire battery train line. The electric controls of the trains and the starter motors on the engines are operated on 32-volt battery current. Under normal operating conditions the Exide batteries are kept up to charge by a 1½-kw. generator mounted on each engine, but there is also provided a 5-kw. generator directly connected to a 220-volt a.c. motor which can be operated on power from the train line.

Space is set aside in the engine room of each Twin Cities Zephyr for two Vapor automatic oil-fired boilers, because, no provision for train heat is made in the single unit locomotives for these trains. Each heating boiler has an evaporating capacity of 800 lb. per hour and operates at 200 lb. per sq. in. pressure. The fuel for the boilers and the Diesel engines is carried in a stainless-steel tank suspended between the floor structure and the under sheathing.

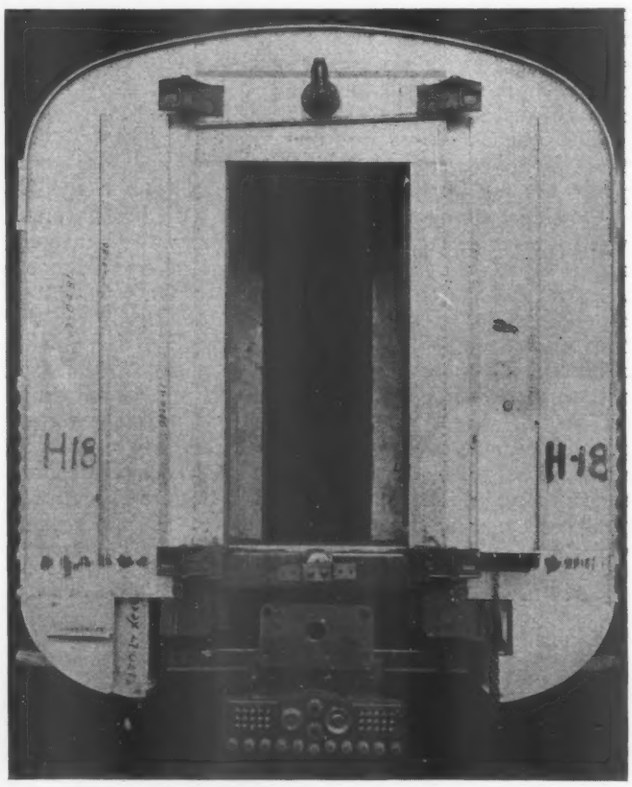
The Vapor heating system in these trains includes provision for returning approximately 75 per cent of the condensate from the radiators in each body unit to the supply tank. This system employs the standard type of Vapor regulator in the connection, above which is inserted a fitting by means of which most of the condensate is diverted to a sump underneath the car body. There is unobstructed communication, however, between the radiators and the Vapor regulator so that the usual temperature control of vapor admission to the radiators is effected by the 25 per cent of the condensate which is wasted. Each of the cars, except the second, is provided with a sump. Under the second car is located the main storage tank for the heating boilers and the condensate drains directly into the main tank.

Each of the sumps under the other cars is provided with a float-actuated solenoid valve which operates to admit air pressure to the sump when full. By this means the water is blown from the sump into the main storage tank.

This water reclamation has made possible a material saving in weight. Storage is provided for slightly less than 6,000 lb. of water, whereas over 20,000 lb. would have been required had all condensate from the radiators been wasted.

### Air Conditioning

The air-conditioning equipment is as made by the Frigidaire Corporation and consists of electrically driven




One of the semi-permanent drawbar connections

compressors and condensors mounted beneath the floor of the cars with overhead thermostatically controlled, combination cooling and heating units and blowers. Each of the air-conditioning compressors is driven by a 220-volt, 3-phase a. c. line-start induction motor, with a full-load current of 38 amperes and a starting current of 166 amperes. A device called a program starter makes it impossible for two or more motors to start simultaneously. The air distribution is accomplished by openings in overhead ducts. The coaches, lounges, dining cars and parlor cars are fitted with overhead air ducts which deliver the conditioned air through an opening between the false ceiling and the underside of the lighting duct. The ducts are provided with vanes and other means for controlling delivery of air. In the section cars conditioned air is delivered by openings in the underside and on the side of the overhead ducts and, in addition, the air is conveyed to the lower berth by

vertical ducts which are built into the section headboards.

Filtered fresh air for the air-conditioning system is taken through openings in the sides of the car roof. Side-wall radiators, under thermostatic control, are located close to the floor. The thermostatic control of overhead and floor heat and cooling equipment is similar to that employed in existing installations on air-conditioned cars.

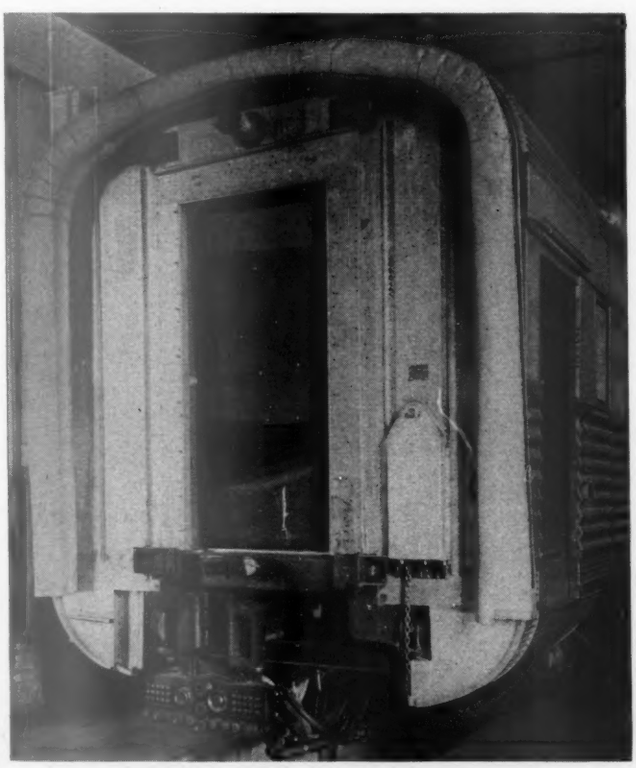
The kitchen ventilation comprises an air curtain to prevent kitchen odors from reaching the dining room, and three large Safety overhead exhaust fans. The air curtain is formed by outside air, taken through a grilled opening in the roof side, which is directed across the pantry-dining-room doorway in a layer from a duct constructed on either side of the doorway. The exhaust fans draw only a small amount of conditioned air from the dining room in excess of the air from the curtain.

Despite the lack of perceptible drafts the circulation of air in these cars is complete every two minutes. Enough fresh air is taken in during the operation of the air-conditioning equipment to provide a change of air in approximately seven minutes.

### Lighting

Thirty-two-volt lighting is used throughout the trains. There is a 5-kv.a. single-phase transformer in each car, these transformers being connected over the three phases of the lighting train line, so as to balance the load in each phase. In addition to the 32-volt secondary for lighting, the transformers have a 110-volt tap which supplies outlets, in washrooms, drawing rooms, bedrooms and compartments, for electric razors, heating pads, curling irons, etc.

Emergency lighting is supplied from the battery. In case there is no 220-volt a. c. power available, a relay connects certain interior car lights, passageway lights, markers, etc., to the d. c. train line. When the a. c. circuits are again energized the relay is restored automatically to its former position and all lights are again operated from the a. c. power source.



An O-B Tight-Lock coupler and connector in place

All cars but sleepers and the observation-lounge sections of the rear cars have general indirect lighting provided by lighting troughs on either side of the central ceiling air-conditioning duct. The troughs are equipped with 25-watt lamps on 10-in. spacings, where the light is not augmented by baggage-rack fixtures.

Baggage-rack fixtures are used in the coaches and in the parlor sections. These are Safety Car Heating & Lighting Company fixtures, having double prismatic light distribution control and individual toggle switches. There is one 25-watt lamp in each unit and there is one unit over each coach seat or over each parlor chair. Where baggage-rack fixtures are used the ceiling ducts have 15-watt lamps on 15-in. centers.

Luminator lens-type lighting units, equipped with 25-watt lamps, are used in passageways, vestibules and in some washroom locations. There are also 25-watt step lights in louvered fixtures which throw light on the lower step. These lights are switched on automatically by the lowering of the step.

Two new types of Safety fixtures are used in the sleepers. The ceiling lights consist of an inverted white bowl, in which the light source is concealed by a longitudinal aluminum strip or band. Glass risers on either side of the band further diffuse the light. The unit is equipped with a 75-watt lamp.

The lower-berth lamps are also novel in form. They are spherical and are made of opal glass with a clear-glass circle or lens to furnish localized intensity for reading. One of them is fitted with a blue night light controlled by a toggle switch under the window sill. Each light has its own toggle switch for its 25-watt white light. The upper berths have two 15-watt fixtures of semi-spherical opal glass. The floor is lighted by aisle lights placed between alternate pairs of sections and staggered on opposite sides.

The observation section of each rear car has diffused lighting fixtures, making continuous cove lighting over the windows. These cove lights are fitted with double 25-watt receptables on 20-in. spacing. In the Denver Zephyr cars general lighting and lighting decoration is provided by a central ceiling light of molded flashed opal glass. It is semi-cylindrical in form and is made in ribbed sections which provide a continuous line of light. The light source consists of Lumiline lamps.

### Brakes

The trains are equipped with electro-pneumatic modified HSC control air brakes operated by air pressure supplied from the locomotive. The cars are equipped with retardation controls which function on four selected speeds and operate in conjunction with the speed-control governors located on certain trucks in the train. The communicating signal is electro-pneumatic up to the first car in which is placed a solenoid valve to reduce the pressure and to operate with a charged signal pipe on the locomotive. Push buttons are located throughout the train in vestibules and other necessary points.

A control box is concealed in the table at the rear end of the observation room which contains train-signal push buttons, a back-up control valve, switch for the back-up lights, and a valve for the back-up horn. An easily operated trap door in the table gives access to the controls.

### Trucks

All car trucks are four-wheel, double-equalizer, swing-bolster type with 33-in. wheels on an 8-ft. wheel base. The castings are of nickel steel, double annealed and drawn. The equalizers, spring-hanger safety straps,

cross-bar and swing hangers are steel forgings. The journals throughout are fitted with Timken roller bearings. Four hydraulic shock absorbers are applied on each truck to dampen the lateral swing action of the bolsters, and the application of special low cold flow rubber has been made at the points necessary to control the transmission of sound.

### The Locomotives

The locomotives for these four trains were built by the Electro-Motive Corporation at La Grange, Illinois. The leading units of the two 3,000-hp. locomotives for the Denver trains are practically the same in detail as the two 1,800-hp. locomotives for the Twin Cities trains. These units each weigh about 222,000 lb. and are 56 ft. 9 in. in length. Each houses two 900-hp. Diesel-electric power plants. These plants are EMC 12-cylinder, V-type, two-cycle engines, each directly connected through a flexible coupling to a General Electric d.c. generator. The power produced by each prime mover is delivered to the driving wheels from the generator through General Electric traction motors and control apparatus. The only interconnection between the transmissions from the two engines is in the control. Each truck has two nose suspended traction motors which are forced-draft ventilated by air supplied from centrifugal blowers driven by the main engines. The fuel tank holds 800 gal.

Auxiliary equipment consists of an auxiliary generator for main-generator excitation, charging the battery, operating locomotive lights, fuel pump and control equipment, a mechanically driven compressor and the air intake fans. A 32-volt MVAH 25-plate Exide Ironclad battery is furnished with each unit to supply power for starting, transmission control and all locomotive lights. These batteries have a capacity of 450 amperes at the ten-hour discharging rate.

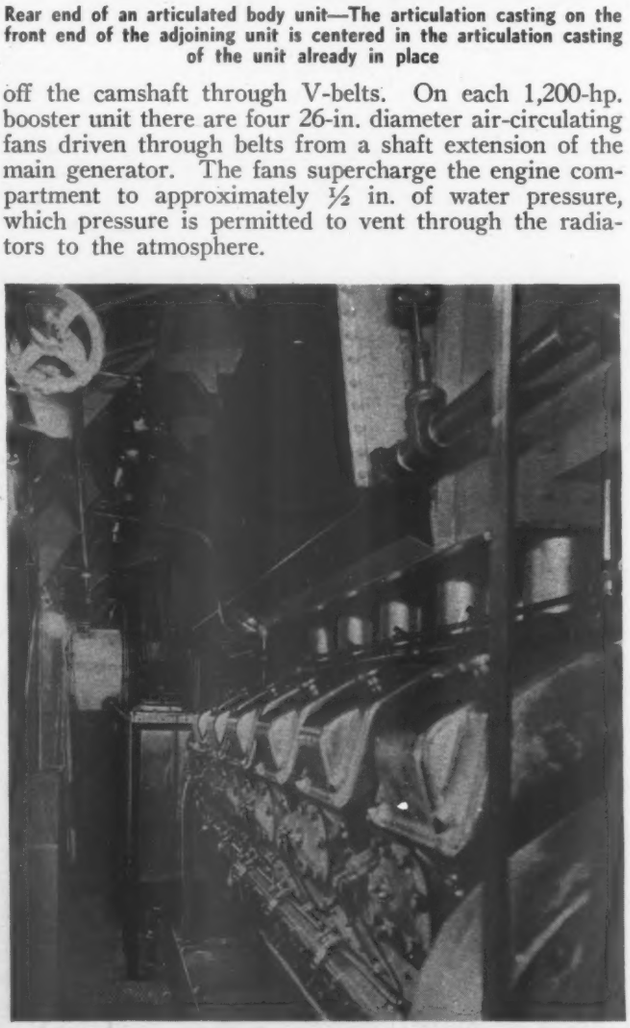
The second unit of each of the 3,000-hp. locomotives, known as a booster unit, houses an EMC 16-cylinder, V-type, 1,200 hp., two-cycle Diesel engine directly connected through a flexible coupling to a General Electric d.c. generator. The auxiliary equipment for this engine is practically the same as that for each of the two power plants in the 1,800-hp. locomotive unit. In addition to those already mentioned each of the power plants includes a Gardner-Denver mechanical air compressor directly connected through flexible couplings from the shaft extension of the main power plant. These are two-stage, water-cooled machines with intercoolers and each is equipped with an unloader valve controlled by a governor. The rated displacement of each compressor is 79.4 cu. ft. per minute at 750 r.p.m. This unit is 55 ft. in length (over the body) and weighs 206,000 lb.

The booster unit also houses two vapor automatic oil-burning boilers, each rated at 1,500 lb. of water per hour at 200 lb. steam pressure. This unit carries a feed-water tank of approximately 1,000 gal. capacity and the burners of both boilers receive their fuel from the main fuel tank. This tank on the booster unit has a capacity of 980 gal.

The cooling system on both units is essentially of the same type as that on the earlier Zephyr trains. Each engine has its own separate system. The radiators are of the fin-tube type and are mounted in two sections, parallel to the engine and supported from a removable hatch directly over the engine. The water-supply tank is located below the level of the radiators to permit draining of the radiators when the engine is not running. A water circulating pump is located on the engine at the rear of the blower gear case. On each 1,800-hp. unit there are two 34-in. diameter air-circulating fans for each of the 900-hp. engines, these fans being driven

**Rear end of an articulated body unit—The articulation casting on the front end of the adjoining unit is centered in the articulation casting of the unit already in place**

off the camshaft through V-belts. On each 1,200-hp. booster unit there are four 26-in. diameter air-circulating fans driven through belts from a shaft extension of the main generator. The fans supercharge the engine compartment to approximately ½ in. of water pressure, which pressure is permitted to vent through the radiators to the atmosphere.



**One of the 900-hp. Diesel engines**

An exhaust muffler for each Diesel engine is located in a well in the hatch directly above the engine. The muffler is connected to the engine by individual pipes to each cylinder and exhausts to the air through stub riser pipes.

Each engine has its own complete lubricating-oil system which consists of an oil tank, oil cooler, oil filter and pump. The oil supply reservoir is a copper tank having a capacity of 60 gal. with a large opening at the top for easy filling. The oil cooler (two of these units are used with the 1,200-hp. engine) is a compact, water-cooled unit which has ample capacity to maintain the oil at the proper temperature. Large size oil filters are

**Lengths and Truck Weights of the Body Units of the Denver Zephyrs**

| | Length over couplers, ft.—in. | Weight | |
|---|---|---|---|
| | | Truck numbers | Lb. |
| Auxiliary power-mail-baggage car | 84—6 | 1 and 2 | 122,200 |
| Comb. baggage, crew quarters, cocktail lounge | 84—6 | 3 and 4 | 88,250 |
| Coach | 76—3* | 9, 10, 11 and 12 | 217,900 |
| Coach | 64—0† | | |
| Diner | 73—6* | | |
| Open-section sleeper | 76—3* | 13, 14 and 15 | 163,840 |
| Open-section sleeper | 76—3* | | |
| Open-section sleeper | 76—3* | 16, 17 and 18 | 168,290 |
| Drawing room, bedroom, compartment sleeper | 76—3* | | |
| Parlor, observation-lounge | 78—8 | 19 and 20 | 80,990 |
| Total | 766—5 | | 841,470 |
| Locomotive | 117—4 | | 428,000 |
| Total with locomotive | 883—9 | | 1,269,470 |

* From coupler pulling face to articulation center.
† Between articulation centers.

installed ahead of the cooler. The pump is driven by the main engine.

The lubricating-oil system includes the use of two dry sumps, one at each end of the crank pan, fitted with removable strainers. A dual scavenging pump draws the hot oil from these sumps and passes it through the filter and oil cooler to the oil supply reservoir. Cool, filtered oil is taken from the supply tank by the pressure pump and distributed throughout the engine at the required pressure as regulated by a pressure relief valve, which discharges into the crankcase. A device is provided to close the engine throttle in the event of a deficient oil supply.

**The Diesel-generator sets in the first car carry the auxiliary and lighting loads**

The locomotive body frame construction comprises a welded steel truss of the Howe type. There is no center sill. Buff and drag stresses are transmitted to the lower chords of the side trusses through beams which take the place of end sills. The members of each truss are connected top and bottom with large gussets and welded together in one unit. Where the frame members connect with the trusses, gussets develop the full value of the members. The floor and all equipment are supported on the bolsters and on cross members carried by the side trusses. At each end of the roof hatches, in addition to the end frame, extremely strong arches are provided of sufficient strength to take care of torsional stresses when

**The Length of the Body Units and the Total Length of the Twin Cities Zephyr Trains**

| | Ft. | In. |
|---|---|---|
| First body unit, from face of front coupler knuckle to rear articulation center | 76 | 3 |
| Second body unit, between articulation centers | 64 | 0 |
| Third body unit, between articulation centers | 64 | 0 |
| Fourth body unit, between articulation centers | 64 | 0 |
| Fifth body unit, between articulation centers | 64 | 0 |
| Sixth body unit, from front articulation center to rear of body | 75 | 5 |
| Total | 407 | 8 |
| Locomotive | 59 | 8 |
| Total length, including locomotive | 467 | 4 |

jacking up the locomotive body at diagonally opposite corners. The stainless steel exterior and the front end are similar to those on the previous Zephyr trains. The front end sill of the 1,800-hp. units is 5 ft. deep and extends down to within 15 in. of the rail. The outside sheathing is supported on the trusses and carries no part of the body stresses. The structure is designed to meet the specifications of main-line railway mail service.

The material used in the locomotive body construction consists of high-tensile, carbon-molybdenum steel in all members where the section size is determined by stress. Members in which the sections are determined by the necessity for stiffness and not stress are made of mild carbon steel.

The cab or operator's compartment is separated in the forward end of the 1,800-hp. unit with the floor elevated

**Weight of the Twin Cities Zephyrs by Trucks**

| | Weight, lb. |
|---|---|
| Leading truck under engine-room-cocktail-lounge car | 73,200 |
| Second truck, between cocktail lounge and first coach | 64,520 |
| Third truck, between the coaches | 58,430 |
| Fourth truck, between the coach and kitchen end of diner | 71,240 |
| Fifth truck, between diner and parlor car | 65,490 |
| Sixth truck, between parlor cars | 63,430 |
| Seventh truck | 40,030 |
| Total | 436,340 |
| Locomotive | 222,520 |
| Total, including locomotive | 658,860 |

to furnish an unobstructed view of both sides of the track. An insulated steel partition with doors separates the cab from the engine room and outside entrance door is provided on each side. All cab windows and doors have shatterproof glass and air-operated windshield wipers and window defrosters are installed on the front windows. All three power plants in the two-unit 3,000-hp. locomotives are operated from the one control station by means of the EMC multiple-control system.

All trucks are four-wheel power trucks of EMC design, equipped with Commonwealth alloy cast-steel frames, tested in the rough to 2½ times their normal

(*Continued on page 25*)

FIG. 1

FIG. 2

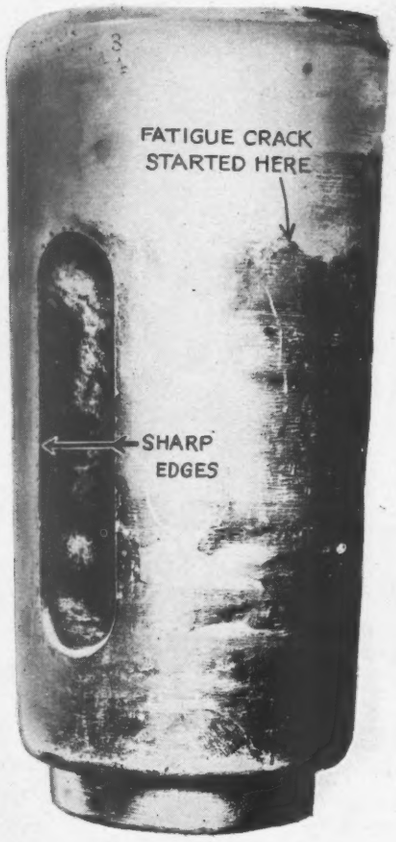



FIG. 4

FIG. 3

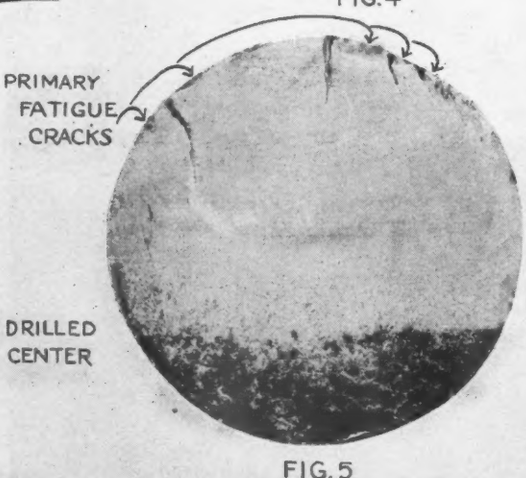



FIG. 5

FIG. 6

Failures of

# Locomotive Parts*

By F. H. Williams†

FEW failures of piston rods can be attributed to defects in the materials from which they are made—carbon and alloy steels—and the comments in this article will be confined to failures caused by poor workmanship and service conditions. It is easy to allocate a failure to one of three principal causes, and a brief study of the fractured ends will enable the decision to be made promptly. A further check is then required to make sure that the cause is that which was first assumed and that no other factors were involved.

We shall consider in this article only those failures occurring just inside the crosshead fit. This is a weak section and most of the failures starting therein are caused by stress-corrosion cracks. The corrosion is the result of pressure on the surface of the taper fit of the rod, because of the crosshead being keyed tightly on it. The surface is thus under pressure. On the other hand, there is alternate stretching and compression of the surface fibers when the piston is in operation. These reverse stresses, combined with the corrosion, start minute cracks, which in time develop into fatigue cracks and finally cause a complete failure of the rod. Even though the finish in the keyway itself may be defective, so that in time failure may result, it is significant that the breaks usually occur in this weak section.

### Inspection of the Taper Fit

A considerable number of piston rods are scrapped long before they actually fail and much damage is thereby avoided; this is due to careful inspection of the rods, usually by the use of whitewash and a few blows with a hammer. When such rods are removed from the crosshead, they are cleaned and the taper fit is whitewashed and allowed to dry. It is then hit several blows with a sledge; if there are any cracks, the oil oozes out and leaves a stain on the coating of whitewash. Such cracks are from ¼ in., or less, to several inches in length. Obviously the rod must be scrapped. I have known of 13 piston rods being scrapped for this reason in one week in a main shop—a rather heavy casualty list, particularly on a large system which may have several such shops.

Who is to blame for such failures? For some reason there seems to be a tendency to cover them up. This is unfortunate, for it is only by having them carefully reported and checked up that the actual conditions become known and steps can be taken to give the necessary amount of study and research to overcome the weakness. It should therefore be the shopman's first duty to report failures, so that the cause may be located and steps taken to reduce them to a minimum.

Figs. 1 and 2—Showing location of cracks in the taper fit of a piston rod. The fatigue cracks start in the corrosion pits. Fig. 3—Broken piston rod resulting from cracks in the rust or corrosion band. These apparently did not start in line with the keyway, but on either side of it. Fig. 4—Piston rod which had to be scrapped because of fatigue cracks starting in a corroded section. Fig. 5—Fractured end of a piston rod which failed in service. Fig. 6—Side view of a broken piston rod, the fractured surface of which is shown in Fig. 5.

### Stress-Corrosion Cracks

The photographs in Figs. 1 and 2 show defects in the taper fit of a piston rod. The fine cracks start in the corrosion pits, developing into fatigue cracks as the result of the reverse stresses combined with corrosion. It is interesting to note that these cracks are not in line with the keyway slot, but are to one side or the other of it. They are so fine that they do not show on the photograph, but the locations are indicated by the arrows.

The final results of such stress-corrosion cracks are shown in Fig. 3. They eventually develop into fatigue cracks and cause the failure of rods in service, unless they are disclosed by inspection while they are in process of developing. The photographs show clearly the band of corrosion pits, the cracks apparently starting at the points indicated by the two X marks. It will be noted, again, that these are not in line with the keyway slot, but are on either side of it. The edges of the keyway are also poorly finished and the holes at the ends of the keyway were drilled off center. These are hot beds for failures, but the more deadly enemy, the stress-corrosion cracks, beat all comers and caused the failure.

In the case of another broken piston rod, Fig. 4, the cracks occur farther down on the taper fit and about on a line level with the top of the keyway. Interestingly enough, the cracks did not start at the keyway, but well to the right of it. They were discovered by an inspection with the whitewash and hammer test. It may be well to note, also, the defects in the finish of the keyway. The punch marks at the top of the keyway are not good practice and should be severely condemned. The edges of the keyway are also too sharp and should have been rounded off with a good radius.

Figs. 5 and 6 show how another piston rod failed in the taper fit. In this case the fatigue crack extended almost across the section before the final failure. The rougher texture of the break indicates that section which parted last. Fatigue cracks started in several places, finally joining up and gradually extending until the rod was broken.

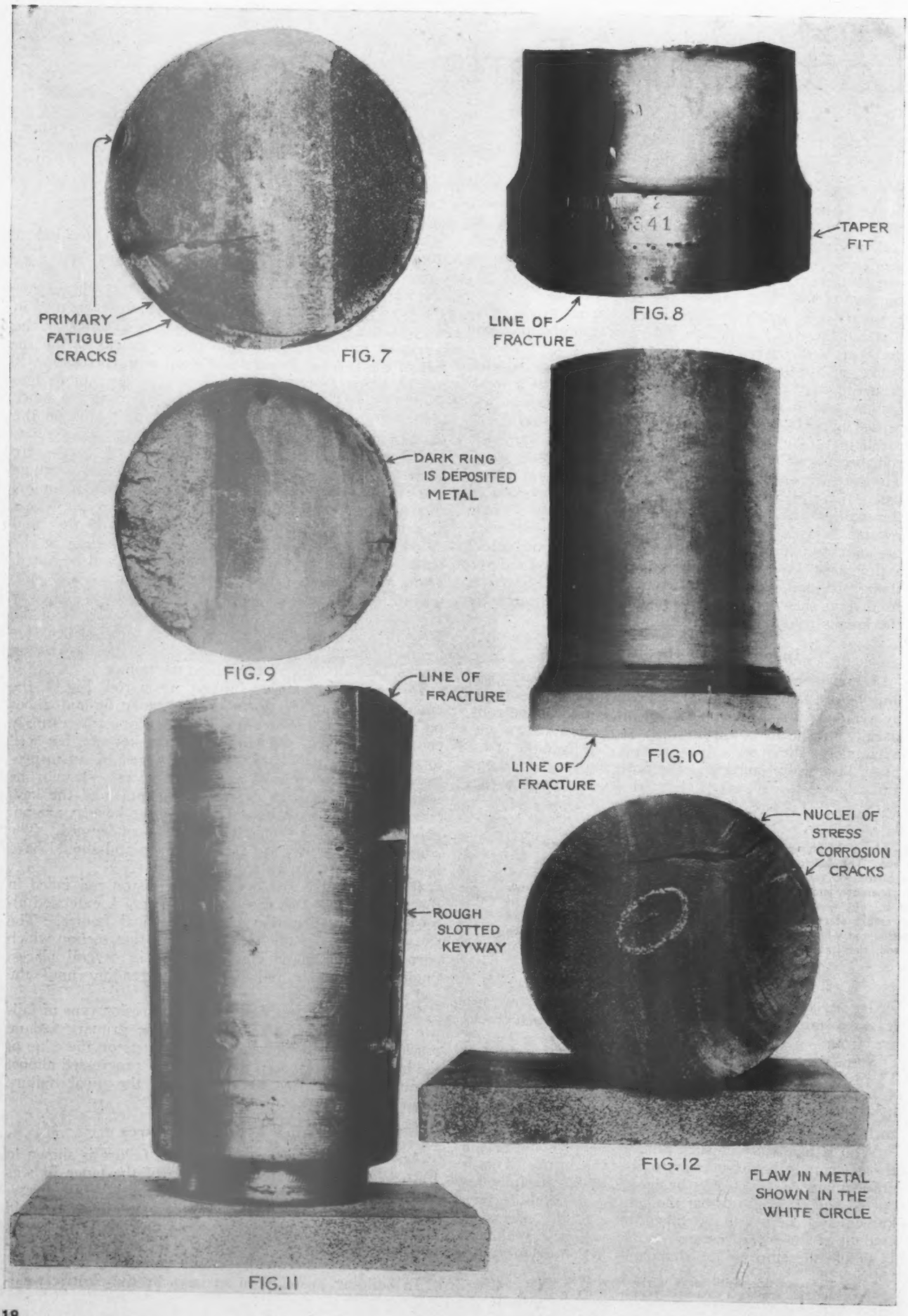
Still another instance of a stress-corrosion type of failure is shown in Figs. 7 and 8. The primary fatigue cracks are indicated by the black sections on the edge of the break. Here, again, the crack had progressed almost through the entire section before the final failure occurred.

### Other Types of Failures

Another and more unusual type of failure is shown in Figs. 9 and 10. Here the surface of the taper fit was built up by the electric welding process. While stress-corrosion cracks probably also had some effect, it would appear to be poor practice to build up rods in this way, particularly since special attention is not given to preheating before the welding, and annealing thereafter.

In building up of worn surfaces by the electric weld-

* Part 7 of an article which began in the May, 1936, issue.
† Assistant test engineer, Canadian National Railways.


PRIMARY FATIGUE CRACKS
FIG. 7
TAPER FIT
LINE OF FRACTURE
FIG. 8
DARK RING IS DEPOSITED METAL
FIG. 9
LINE OF FRACTURE
LINE OF FRACTURE
FIG. 10
NUCLEI OF STRESS CORROSION CRACKS
ROUGH SLOTTED KEYWAY
FIG. 12
FLAW IN METAL SHOWN IN THE WHITE CIRCLE
FIG. 11

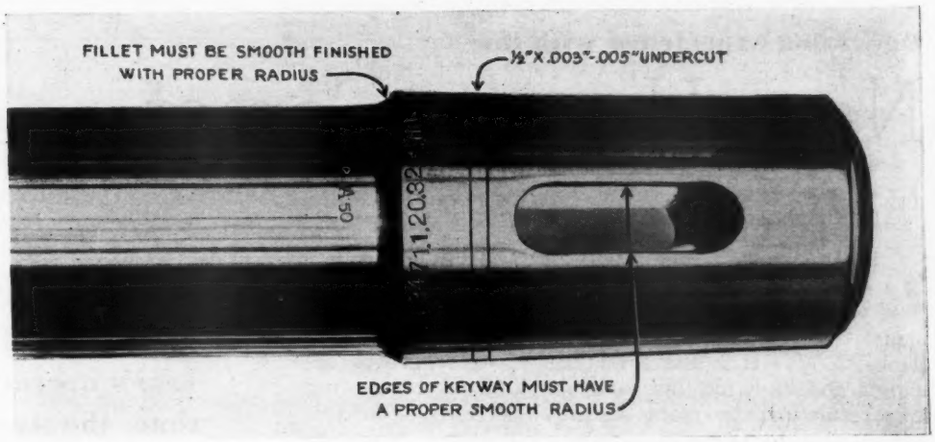



Fig. 13—Showing how piston rod should be finished

ing process the parts should be clean and free from grease. They should be preheated to from 1,100 deg. to 1,200 deg. Fahn. and kept there during the welding operation and then be allowed to cool slowly. The rod then *should not be annealed.* Tests have shown that such annealing is positively dangerous. Nitrides in the metal as deposited are generally harmless, but the annealing changes them into nitride plates which are dangerous, making the steel brittle and prone to crack. This applies generally to bare and some coated rods, but not to some of the modern properly coated rods. Annealing must not be regarded as a cure-all. Preheating is absolutely necessary in the higher carbon steel rods.

In the case of the break illustrated in Figs. 11 and 12, we find that it was primarily caused by stress-corrosion cracks. The fracture, however, indicates that there was also a flaw in the metal, although this seems to have played little part in the final failure, the cracks obviously starting from the surface.

The line of fracture, as shown in Fig. 11, appears in a rust or corrosion band, the frilled edges indicating that the cracks started in several different places and joined up as they progressed. The steel in this rod appears to be good and the crack had progressed more than half way across the section before the break occurred. It will be noted, also, that the taper fit is poorly finished; and that the holes in the ends of the keyway were drilled off center and the slotting of the keyway was unusually rough.

As the result of the study and investigation of such failures as have been described, piston rods are now being finished as shown in Fig. 13, except that the undercutting is not as yet used. Stress-corrosion cracks result from surface tension in the area of corrosion. Such surface tension, with infinitesimal stretching, results in frictional corrosion, which causes slight pitting in extreme cases, and the starting of stress-corrosion cracks. If you examine a piston rod removed from a crosshead after considerable service, it will be noted that the surface of the taper fit is coated with a fine red or black powder of iron oxide. If the case is a bad one, there will be a series of corrosion pits or even a band of corrosion slightly under the normal diameter of the rod. Even the best possible finish will not prevent such corrosion areas—the nesting places of stress-corrosion cracks.

In my opinion, such stress-corrosion cracks can only be prevented by undercutting or under-rolling, as indicated in Fig. 13. Ordinary finish will not give satisfactory service; ground finish will not do; the grinding and rolling of the surface will not suffice, so long as the whole surface is under pressure and reverse stresses. To get away from this we must undercut or under-roll a short band, about .003 to .005 in. deep and from ¼ in. to ½ in. thick. Undercutting removes the pressure from the surface in tension and tension from surfaces under compression. Such undercutting has been used for other parts with success, and it is urged that it be applied to piston rods as a real preventive for one of the most disastrous of causes of piston rod failures.

The grade of steel has little to do with the prevention of such failures. I have found that the best nickel steel will develop stress corrosion cracks as readily as carbon steel, although it is true that the better quality of material will lengthen the life of the rod before failure. In conclusion, we must not forget that the undercutting must have a perfect finish—polished surface, fillets and radii—else it will fail in accomplishing its purpose.

* * *

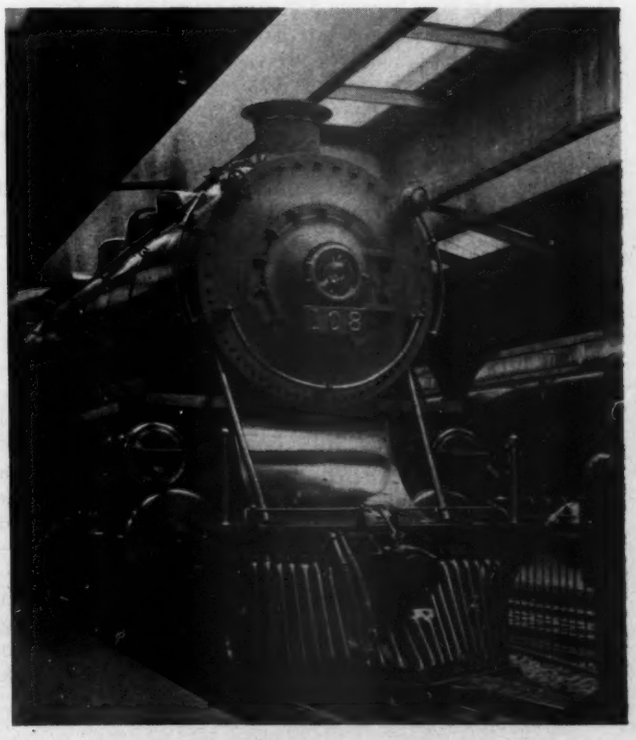


Fig. 7—Fractured face of broken piston rod, showing clearly the primary fatigue cracks. Fig. 8—Showing location of break in taper fit of piston rod. (Face of fracture shown in Fig. 7). Figs. 9 and 10—Fatigue cracks of this broken piston rod started in metal added in building up by electric welding process. Figs. 11 and 12—Break caused primarily by stress-corrosion cracks, although there is also a flaw in the metal as indicated by the chalk mark.

**Operating experience with the**

# New Haven Comet

**By P. H. Hatch***

**A record of the results of a year's operation, during which time the train ran 139,000 miles. Performance of Diesel engines an outstanding feature. Fuel consumption averaged one-half gallon per mile**

THE New Haven Comet, in April, 1936, completed its first year of operation as a high speed, de luxe train in shuttle service between Boston, Mass., and Providence, R. I. It is the first train of its type ever designed and built for this particular kind of service, and as a result includes many features—not only of interest but of hitherto untried operating experience. Now that the first year has been successfully negotiated and annual repairs completed, there has been an opportunity to appraise the various features of the train in the light of actual performance.

The Comet came east from Akron, Ohio, and was delivered to the railroad on April 27, 1935. Prior to this time it had undergone extensive adjustment and running tests, including some high-speed trials in which a speed of 100 m.p.h. was attained on straight, level track with the train still accelerating when the end of the test section was reached.

Between April 27 and June 5, 1935, the train was engaged in an extensive exhibition tour and a series of excursion runs. After making a total of about 4,500 miles in this manner, it entered regular service of five round trips each week day between Providence and Boston with an intermediate stop at Back Bay, a daily mileage of 440. On Sundays it was usually operated in special excursion service, the trip from Providence to Provincetown, Mass., on Cape Cod, and return proving especially popular.

With the timetable change on September 29, 1935, the schedule of the Comet was changed to include six round trips each week day between the two cities, and another station stop was included at Pawtucket-Central Falls. Daily mileage now became 528, and on alternate Sundays special excursion trips from Boston to New York and return were inaugurated. In connection with the institution of the additional stop it is interesting to note that it has caused no change in the mile-a-minute schedule between Boston and Providence, and has had little effect on maximum speeds in either direction.

Putting a train like the Comet into service presented several problems, the two most important being the instruction and training of operators, and the institution of a suitable and adequate maintenance program.

To start the train off, four enginemen, including the three who had "bid in" the Comet runs were sent to Akron, and handled most of the test runs there, the run east to New Haven, and the exhibition and excursion runs before the inauguration of regular service. At the start of this, therefore, there were available experienced operators. There was still, however, the problem of spare operators who would be available for extra runs or in case any of the regular men were off. Hence a number of enginemen from both Boston and Providence were qualified in the operation of the train. The procedure consisted of instruction on the train by an automotive inspector and an air brake supervisor, riding in the operating compartment, actual experience in handling the controls, and finally a written examination based on the book of operating instructions, supplemented by a demonstration on the train of proficiency in operation and handling. Re-qualification is required of men who have not operated the Comet within a stated period of time.

With the start of regular service on June 5, 1935, a daily schedule of maintenance and inspection was drawn up and put into effect at Providence where the train had its headquarters. A weekly schedule and a monthly schedule were also set up and made effective, and this work was done at Boston by the regular gasoline rail car organization at that point. With the timetable change and the daily six round trips instituted the latter part of September, the Comet was based in Boston, and the entire program of daily, weekly and monthly maintenance and inspection activities was undertaken by forces specially organized there. All the spare parts and supplies were concentrated at Boston also, so that this point became the Comet headquarters.

### Maintenance Provision

The Comet has already been extensively described in different publications. The various features of the train, however, have such an important bearing on the kind and degree of maintenance attention that they will be briefly enumerated here.

In each end of the train are two entirely separate and distinct Diesel-engine generator sets. Each consists of a six-cylinder, 9-in. bore by 12-in. stroke, four-cycle, non-supercharged, Westinghouse Diesel engine rated 400 hp. at 900 r.p.m., and weighing about 23 pounds per horsepower without bedplate. Direct connected to each engine is a Westinghouse main generator with a continuous rating of 240 kw. and an auxiliary generator of the same make with a similar rating of 34.5 kw. On the motor truck under each end of the train are two Westinghouse 145 hp. (continuous rating) traction motors supplied with power from the adjacent engine generator set. The traction circuits in each end of the train are not connected together in any way; the speeds of the two Diesel engines, and series, parallel and reduced field connections of the two traction motors on each power truck, however, are simultaneously controlled from either end of the train. On the auxiliary circuit side the two power plants operate in parallel, whether supplying power from the main generators dur-

* Assistant engineer, New York, New Haven & Hartford.

ing idling, or from the auxiliary generators at other times.

Auxiliaries on the Comet comprise control apparatus, battery and battery charging equipment, fuel transfer pumps, air compressors and motors, motor driven radiator fans, air conditioning and ventilating equipment, lighting apparatus, etc., and result in an exceptionally heavy auxiliary power demand. As an example, the lighting load alone requires up to 9 kw.

Other train auxiliaries include electro-pneumatically operated doors and folding steps interlocked with the air brake system to prevent injuries to passengers; oil-fired heating boiler with automatic control; specially developed air brake system with the decelakron feature for high speed operation—all of which have a direct bearing on train operation and maintenance.

Applying to the Comet the same principle of organized inspection and maintenance which has been so successful in the operation of electric locomotives and multiple unit equipment, lists of items to be attended to at daily, weekly, and monthly intervals were drawn up and put into effect. A so-called "work book" was installed on the train in which operators are required to list various information regarding operation, including defects noted for each trick worked, so that definite, thorough procedures were established for necessary attention. In the case of weekly and monthly work lists, mimeographed copies are sent in to headquarters showing that each item was inspected and left in OK condition; special work, or notations showing additional details regarding any of the items listed are shown on the reverse of the sheets.

To illustrate the system in general, the "Weekly Schedule of Inspection and Maintenance" of the Comet is reproduced below. The monthly schedule is quite similar except that it is considerably longer by reason of calling for additional items of work and more detailed inspection of parts.

It goes without saying that work lists of the kind mentioned are effective only to the extent that the forces doing the work are familiar with the type of equipment involved, are conscientious in the performance of their work, and are efficiently supervised. In this respect the railroad was fortunate in having available a group of maintenance men thoroughly familiar with gas-electric cars, so the transition to the Comet work was comparatively easy.

### Operating Experience

Up to the time the train was taken out of service for annual repairs in April, 1936, the total mileage since the start of regular service on June 5, 1935, was 133,000 miles. This is exclusive of the approximately 6,000 miles run previously in testing, exhibition and excursions prior to June 5, or in other words, represents about ten and a half months of revenue operation.

Diesel-engine hours of operation for this period total roughly 4,500 hours, or at the rate of 5,200 hours per year; thus, though the total mileage may be low in comparison with other high-speed streamlined trains because of the characteristics of frequent shuttle service, the hours of service of the Diesel engines are comparable with engine hours for trains making greater mileage.

The necessity for quick turn-arounds at terminals dictated the double-end, two-power plant type of train; actual operation in service has shown this design to have incidental advantages of considerable importance. The use of a motor truck under each end of the train with the weight of a power plant thereon has resulted in smooth, even riding and tracking qualities with total ab-

### Weekly Schedule of Inspection and Maintenance

#### A—Oil Engines

1. Drain fuel oil strainers (two in each engine room).
2. Make cylinder head inspection and check for fuel pipe leakage. Take up on holding down nuts.
3. Check end bearings and piston skirts.
4. Inspect throttle operating mechanisms and interlocks.
5. Clean air intake filters (alternate weeks).
6. Clean lubricating oil filter bags or install clean sets (alternate weeks).
7. Check all fuel pipes for chafing.
8. Check oil and water piping for leaks.
9. Drain water from fuel oil tanks.
10. Take care of oil engine items reported in work book.
11. Wipe down engines with rags.
12. Take sample of crankcase oil from each engine and forward promptly to laboratory at New Haven.

#### B—Electrical Equipment

1. Blow out and thoroughly clean main and auxiliary generators. Inspect brushes, brushholders, commutators, wiring around and under generators, etc. Check brush tension.
2. Blow out 600-volt cabinets and auxiliary apparatus cabinets and check all wiring, connections, shunts, fuses and blocks, etc.
3. Inspect and clean all contactors, unit switches, reversers, relays, interlocks, etc.
4. Inspect and clean master controllers and push button boxes.
5. Blow out and thoroughly clean main motors. Inspect brushes, brushholders, commutators, leads, etc. Check brush tension.
6. Inspect all main motor leads for chafing, clean off oil and dirt.
7. Blow out, clean and inspect radiator fan motors, air compressor motors, Freon compressor motors.
8. Inspect and clean fuel pump motors and couplings and check pipe connections for tightness.
9. Inspect and clean evaporator motors.
10. Inspect and clean exhaust fan motors.
11. Inspect and clean service water pump motor and boiler oil and water pump motors.
12. Inspect boiler control equipment and a.c.-d.c. motor-generator set.
13. Check for grounds on 115-volt circuits.
14. Inspect lamp regulators and voltage regulators.
15. Inspect all knife switches, snap switches, canopy switches, flipon switches, etc.
16. Inspect thermostat switches and service water pump pressure switch.
17. Clean both halves of storage battery, take gravity readings and flush, if necessary.
18. Inspect air compressor governor.
19. Inspect all terminal boards.
20. Take care of electrical items reported in work book.
21. Check sequence if any repairs or changes have been made which might affect switch or contactor operation.

#### C—Auxiliary Equipment

1. Inspect air brake equipment and piping.
2. Check air compressor oil levels.
3. Inspect all door engines, door and drum switches, interlocks, etc., and give necessary attention.
4. Check Freon compressor oil levels.
5. Clean evaporator unit air filters.
6. Check over all accessible Freon piping for leaks.
7. Inspect Vapor panels in each car.
8. Inspect magnetic steam valves.
9. Inspect all thermostat tubes and connections.
10. Repair any leaks and drips in steam piping.
11. Inspect boiler and auxiliaries and give necessary attention.
12. Check control line feed valves for proper setting (70 lb.).
13. Take care of work book items.

#### D—Mechanical and General

1. Take care of lubrication of all items shown as due in instruction letter and lubrication chart for The Comet.
2. Give trucks and running gear, brake rigging, etc., detailed inspection and make necessary repairs, replacements, etc.
3. Check hand brakes.
4. Inspect main motor gear cases and add lubricant if required.
5. Take care of work book items.
6. Clean up engine rooms and operating compartments.

sence of rear end whip or bouncing. Also in the case of failure of either power plant it has been possible to cut it out and operate the regular schedule with the loss of only a few minutes, and in some cases, practically on time.

The first six months of operation were notable for the absence of any delay of more than seven minutes due to mechanical or electrical equipment of the train. This particular delay, incidentally, was due to a stuck handbrake at Providence station. Other failures of a minor nature had taken place, but repairs had been made in out-of-service times or had not caused operating delays of any consequence. For instance, it was necessary to rewind all the fuel transfer pump and evaporator fan motors for 140 volts instead of 115 volts, better to accommodate the auxiliary voltage of the power plants. Early in July an epidemic of failures of the air conditioning refrigerant flexible connections between cars at the points of articulation occurred, and was remedied by the redesign of the connections. About the same time, through failure to use the short-circuiting button provided to cut out a defective thermostat switch, all but three inches of cooling water was boiled out of the No. 1 engine system which gave rise to a number of unfounded rumors regarding lack of cooling, though both crankcase oil and cooling water radiator capacity is of more than ample proportions. In this case the No. 1 engine suffered no more serious damage than the necessity for renewal of cylinder head gaskets two or three weeks later. Additional supports for the brake rigging on the trucks were found desirable, and were installed during the summer. Certain bushings on the hydraulic shock absorbers on the trucks showed excessive wear; these were replaced with bushings made of a different material, and operation since then has been satisfactory in this respect.

The first failure of equipment causing the train to be withdrawn from service occurred on September 25, 1935, and was due to the failure of one of the traction motors. There had been a certain amount of conjecture regarding the general problem of running a substitute Comet. This was dispelled in a hurry, however, because of the suddenness with which the failure occurred, and the necessity of continuing service in spite of limited time at terminals. In this case a light Pacific type steam locomotive from a suburban train was pressed into service, and with two streamlined coaches, ran the Comet's schedule until later in the day Atlantic type locomotives were assigned. It is interesting to note that when the Comet is out of service, two coaches and three steam locomotives are required to operate the substitute service. This is, of course, because of the short turn-arounds and crew assignments.

In the first year of operation of the Comet, there have been several other instances of failures resulting in removal of the train from service. Such failures in all cases have been traced to defects in individual equipment parts and not to weaknesses in fundamental design of the train or its equipment. Furthermore the remedial measures taken have eliminated most of the troubles which have occurred.

As was to be expected with an entirely new type of train and service, various interesting problems arose which required special solutions. One was adequate ventilation of the operating cab at each end of the train. The only windows which can be opened are the two, one on each side, farthest around toward the side of the cab, away from the nose. It was suspected that the effect of the streamlining was such as to create a partial vacuum in the cab with those windows open and thereby draw in heated air from the adjacent engine compartment. The trouble was temporarily remedied by cutting ventilating holes in the horn housing at each end which could be closed by means of a slide.

Another special problem last winter was that of rain freezing on the outside of the front windows, also steaming up of the inside of these windows. Accordingly a six-inch non-oscillating direct-current fan was obtained and arrangements made for mounting and plugging it in at either end of the train. The scheme was sufficiently successful that a similar fan has been obtained in order to have each cab equipped. In summer these fans are used for ventilating purposes in conjunction with the holes in the horn housings; still further to assist in keeping the operating cabs cool in hot weather, metal deflectors have been installed.

Fuel oil consumption measured in miles run per gallon for the train as a whole, which includes heating in winter and air conditioning in summer, has averaged a little under two miles per gallon.

Overall Diesel engine fuel consumption for the Comet has averaged one-half gallon per mile run, or in other words, two miles per gallon. Engine lubricating oil consumption has averaged less than 3½ per cent of engine fuel oil consumption, or 60 miles per gallon. These figures are considered entirely satisfactory in view of the excessively high percentage of terminal time to running time which, again, is characteristic of shuttle service. Operating instructions for the Comet call for keeping the Diesel engines running continuously for all lay-overs of an hour or less, and the tendency has been to do this for some of the longer lay-overs also, since air conditioning in summer cannot be had without the power plants running and the storage battery alone is not adequate for supplying lights and main and boiler control demands for long periods without jeopardizing the required margin for Diesel starting.

At first there was some apprehension that so much idling would result in abnormally high dilution of engine crankcase oil, or other undesirable effects. Such has not been the case; dilution, which with other factors is checked by weekly analyses of oil samples, has been found to average about 2.5 per cent for both engines which is considered quite satisfactory. Lubricating oil, incidentally, has been changed at 25,000-mile intervals in both engines.

It is of interest to note that both power plants have operated together in balance throughout. No adjustment since the original final settings of the speed-load control equipment have been necessary as yet.

### Annual Repairs

On April 22, 1936, the Comet was taken out of service for annual repairs and I.C.C. work. Due to the complete facilities available and the experience of the personnel involved, it was decided to handle such activities in the same place and by the same forces as had regularly been maintaining the train, instead of sending it to either of the two main back shops of the railroad.

Attention was centered in the program of inspection and repairs drawn up prior to the shopping, and throughout the work itself, on doing all that was necessary to keep the train in service during the ensuing year without resort to intermediate shopping for other than running repairs. Hence, as an example, all motor truck wheels were renewed, although the old wheels still had two or three months' wear left.

A detailed program of inspection and repairs was drawn up in a form similar to the weekly and monthly itemized lists which covered the four general headings of Diesel engines, electrical equipment, mechanical and general, and heating boiler. The work thus outlined was

done in addition to the regular monthly items due at the same time.

The Diesel engines were given what might be termed a light overhaul which consisted of inspection of cylinder heads and grinding of valves, pulling of pistons and renewal of all rings, inspection of the cylinder liners, connecting rod bearings and crankpins, check of fuel pump balance and timing, re-conditioning of Bosch nozzles, check of torsional vibration dampeners, check of governor condition and automatic timing advance, inspection of all gears that could conveniently be seen, and so on. In addition engine crankcases were thoroughly cleaned, lubricating and fuel oil tanks were cleaned, oil and water radiator gaskets renewed as required, and other works of a similar nature performed.

The electrical overhaul consisted of removal of main and auxiliary generators for inspection of the generator ball bearings, reinsulation and protection of leads, trueing up of commutators, etc. Traction motors were dismantled and cleaned, necessary attention given to commutators, brushholders, pinion and commutator end bearings, leads and so on.

Detailed and minute inspection was made of unit switches, contactors, reversers, relays and other parts of the control equipment and necessary annual attention given.

The air conditioning system throughout the three cars was inspected and the necessary work performed for the ensuing season's operation.

The six side doors were replaced on account of defects in the original doors, and the step treadles were renewed with treadles designed for a higher operating voltage. The door and step opening and closing equipment and control were given a detailed inspection and check.

The heating boiler was washed and given its annual attention preparatory to being taken out of service for the summer months.

Trucks, both motor and articulated, were removed from the train and completely dismantled, and necessary repairs made. As mentioned previously, new motor truck wheels were applied in both motor trucks.

The exterior of the train was cleaned, painted and polished; the interior was entirely repainted and renovated, and drapes and seat back protectors dry-cleaned.

Prior to release of the train, a high-potential test was applied to every electrical part and circuit. Some of this, of course, was required by I.C.C. regulations; the balance was done to eliminate all possibility of grounds due to weak insulation or other defects anywhere. It is interesting to note that no trouble was experienced "shooting" the train, notwithstanding the number and complexity of circuits and apparatus involved. Incidentally, all circuits operate with metallic returns, grounded returns not being employed.

As would be expected, there was great interest to know how the various parts of a train as new as the Comet in equipment and arrangement and as distinct in type of service rendered would come through the first year of operation.

The Diesel engines were found to be in excellent condition; very little wear of parts being observed. Out-side of renewal of all piston rings as a matter of policy, and replacement of gaskets, no new material was required except one turbulent ring (agitator) which had a hair crack in one corner, and two connecting rod bearing shells in which the babbitt had started to shell out. This material sufficed for both No. 1 and No. 2 engines; hence it can be seen that the item of new material required for the engine repairs was practically negligible.

Table I gives the recorded measurements of the cylinder liners made of centrifugally-cast nickel iron. The life of the liner is determined by the wear at the ridge formed at the top of the piston-ring travel. This wear, as is usual, is confined to a small distance as can be noted from the figures showing the diametral wear of .0185 in. and .0185 in. at the ridge to .003 in. and .004 in., one inch below the ridge. The manufacturer recommends a maximum of .075 in. diametral wear at the ridge before scrapping of the liner, and does not favor reboring for oversized pistons as an economical procedure. With the average diametral wear of .0185 in. over a total of 139,000 miles the average wear per 10,000 miles is .00133 in., giving a life expectancy of over 500,000 miles.

Measurement of the aluminum pistons showed an average of .004 in. increase in diametral clearances at

**Table I — Cylinder Liner Measurements**

| | No. 1 Engine | | | | | | No. 2 Engine | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Liner at ridge | | 1 in. below ridge | | 4 in. from bottom | | Liner at ridge | | 1 in. below ridge | | 4 in. from bottom | |
| Cyl. No. | Axial | Trans. | Axial | Trans. | Axial | Trans. | Axial | Trans. | Axial | Trans. | Axial | Trans. |
| 1 | 9.016 | 9.018 | 9.003 | 9.005 | 9.003 | 9.003 | 9.018 | 9.020 | 9.004 | 9.003 | 9.000 | 9.001 |
| 2 | 9.015 | 9.019 | 9.001 | 9.005 | 9.003 | 9.003 | 9.015 | 9.017 | 9.003 | 9.005 | 9.001 | 9.001 |
| 3 | 9.018 | 9.022 | 9.002 | 9.005 | 9.002 | 9.002 | 9.024 | 9.025 | 9.006 | 9.005 | 9.001 | 9.000 |
| 4 | 9.021 | 9.018 | 9.004 | 9.004 | 9.002 | 9.003 | 9.014 | 9.021 | 9.003 | 9.005 | 9.001 | 9.001 |
| 5 | 9.019 | 9.019 | 9.001 | 9.005 | 9.001 | 9.002 | 9.014 | 9.018 | 9.003 | 9.005 | 9.002 | 9.000 |
| 6 | 9.019 | 9.019 | 9.003 | 9.003 | 9.003 | 9.002 | 9.018 | 9.018 | 9.004 | 9.004 | 9.001 | 9.001 |
| Average | 9.018 | 9.019 | 9.002 | 9.0045 | 9.002 | 9.0025 | 9.017 | 9.020 | 9.004 | 9.0045 | 9.001 | 9.001 |
| Average | 9.0185 | | 9.003 | | 9.002 | | 9.0185 | | 9.004 | | 9.001 | |

**Table II — Connecting Rod Bearings**

| | No. 1 Engine | | | | | | No. 2 Engine | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rod No. | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| Vert. | 5.011 | 5.007 | 5.002 | 5.007 | 5.007 | New | 5.0065 | 5.0065 | 5.007 | 5.008 | New | 5.007 |
| Horiz. | 5.009 | 5.005 | 5.0075 | 5.005 | 5.004 | Brg. | 5.005 | 5.006 | 5.004 | 5.003 | Brg. | 5.0045 |

**Table III — Crank Pin Measurements**

| | No. 1 Engine | | | | | | No. 2 Engine | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crank pin, No. | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| Vertical | 4.9975 | 4.998 | 4.9975 | 4.9975 | 4.9985 | 4.9975 | 4.9985 | 4.998 | 4.9975 | 4.9985 | 4.9985 | 4.997 |
| Horiz. | 4.9975 | 4.998 | 4.998 | 4.998 | 4.997 | 4.997 | 4.999 | 4.9985 | 4.9975 | 4.9985 | 4.998 | 4.997 |
| Initial dia. | 4.999 | 4.999 | 4.999 | 4.999 | 4.999 | 4.999 | 4.999 | 4.9995 | 4.9995 | 4.999 | 4.9995 | 4.999 |
| Diametral wear | .0015 | .001 | .0015 | .0015 | .0005 | .0015 | .0005 | .0015 | .002 | .0005 | .001 | .002 |

the extreme top of the piston in line with the thrust and .001 in. parallel to the shaft centerline. Piston skirt clearances did not change during this mileage. The width of the top ring grooves was within manufacturing tolerances, a gratifying condition, as this is generally the wear point on aluminum pistons which necessitates replacements. The wrist pin fit in pistons was the same as when new as the pistons had to be heated in water to effect removal of the pins. The crowns of the pistons were practically free of carbon with $\frac{1}{32}$ in. to $\frac{1}{16}$ in. coat on the underside of the crowns. All drain holes in pistons were clear with exception of drain holes to wrist pins which were found clogged. The piston rings were not measured for wear on account of the practice to renew rings as a matter of course at overhauls; however, no material increase in lubricating oil consumption was experienced during the 139,000 miles.

These engines have high chromium steel rings in the combustion space which give turbulence to the air with beneficial effect to combustion resulting in good exhaust conditions. One of these rings had to be replaced due to a small hair line crack having developed at a sharp corner.

The connecting rod bearings are bronze-back shells lined with Satco lead-base babbitt. Two bearings, No. 6 on No. 1 engine and No. 5 on No. 2 engine were renewed at this time due to small cracks in the babbitt. The condition of these bearings would not have affected performance for a considerable time. Table II gives the recorded readings of the bearings after disassembly and reassembly for measurement. The average vertical clearance was found to be .007 in. and horizontally .005 in. Normal fitting clearance is .003 in. vertically indicating diametral wear of .00029 in. per 10,000 miles. The top end of the connecting rod indicated that the clearance between wrist pin and bronze bushing had increased from .002 in. to .003 in.

Table III shows the measurements made on the crankpins of both engines. The average maximum diametral wear was found to be .0013 in. or less than one tenthousandth of an inch per 10,000 miles. After check of thrust clearance and main bearing lift, it was decided to forego examination of main bearings on account of the more conservative loading of the main bearings compared to connecting rod bearings and the fact that the latter indicated satisfactory lubrication, although receiving their oil supply after the main bearings.

All valves and seats were found in good condition requiring relatively little grinding. The seats are made of steel and are cast in the aluminum head. The valve mechanism is lubricated by force feed at low pressure, giving satisfactory results as indications of wear were negligible.

Inspection of the auxiliaries disclosed satisfactory conditions with no need for replacements or overhaul. None of the gears in the driving trains at the free end of the crankshaft showed signs of distress. The fuel pumps were rebalanced for fuel quantities and adjusted for timing. Atomizers in the cylinder heads were returned to the manufacturer for reconditioning and adjustment.

It is apparent that the Diesel engines were found in remarkably good condition after the first year of operation. In fact it can be said that no feature on the train showed any better condition, if as good. The engines had an almost perfect record as far as responsibility for road delays was concerned.

The general condition of main and auxiliary generators, traction motors, control and auxiliary equipment was found to be good, requiring essentially nothing more than the routine work outlined.

A certain amount of truck work was necessary to correct somewhat excessive wear and breakage of small parts such as sand pipe brackets, pedestal linings, motor nose suspension wear plates, etc., but the main parts, including the shock absorbers, required little beyond routine attention. The superstructure of the train came through the year in fine shape and required no structural attention whatever.

Several cells of the storage battery were opened up at this time for inspection, and serious deterioration of the positive plates was disclosed. Further inspection showed that renewal of all positive plates was necessary immediately, and the battery was returned to the manufacturer for this work. The cause of the trouble was traced to the lack of adequate control of battery charging during idling periods which resulted in excessive overcharging. To correct this, the manually-operated three-position knife switch in each end of the train for controlling charging rates will be replaced at an early date with an automatic voltage regulator. This, incidentally, will also simplify operating procedures considerably in this regard.

Another condition unfavorable to long battery life has been the high temperature of the engine room in which the battery is located. The exhaust ejector system originally furnished for ventilation was not adequate for the amount of radiated heat from the engines and mufflers. Accordingly at the time of annual repairs steps were taken to shroud the manifold muffler of the engine involved and improve the scheme of ventilation by drawing air out from between the surface of the muffler and its shrouding and exhausting it outside. The shrouding of the muffler has reduced engine room temperatures somewhat, and experiments are continuing in working out the correct height of exhaust stack to obtain maximum ejective effect.

After the completion of the annual repairs two days were devoted to road test; the first day a 240-mile run was made with frequent stops initially to check bearings and running gear. When it was apparent that conditions were entirely normal the speed was stepped up until 50 m.p.h. on the return trip was reached. The following day two high-speed round trips were successfully made, and the Comet returned to regular service with the first scheduled trip the next day.

Operation during the summer of 1936 was entirely satisfactory, there being but four delays to service and these of a minor nature. It is felt that such a record for the start of the second year of service indicates both the effectiveness of the annual repair program and the success achieved in eliminating repeated failures of the same type.

## Conclusion

Starting with the timetable change of September 27, 1936, the Comet is again based at Providence, and five round trips operated starting from Providence in the morning. Special Sunday excursions will be run as usual, starting either from Providence or Boston. It is expected that maintenance forces at Providence will handle daily and weekly inspection and maintenance, while Boston with more complete facilities for heavy repairs will handle these and all monthly work.

The Comet is daily performing one of the most exacting and difficult services known to modern transportation; exacting, in that short runs at high speed must be made on the main line of a busy railroad; difficult, in that turn-arounds are brief—there is little or no opportunity to make up time in case a few minutes are lost—and stops are frequent. That the train is conservatively designed and well built is proved by its performance; that it is doing its job as reliably and efficiently as possible for low mileage shuttle service is evidenced by its operating record.

## Necessity for Scientific Research

(*Continued from page 7*)

know is that they found out that you could do it and have gone on doing it in the same way ever since. They worked under great handicaps, both in the lack of precision tools and in the lack of any great metallurgical knowledge. But in spite of the great advance in both of these fields, we, today do not know under what steam pressure and temperature it is most efficient to operate an engine.

The wheels of our locomotives are firmly fixed to the axles which turn in boxes which support and distribute, through springs, the engine weight. Though the attempt was made to turn the wheel on a fixed axle with the addition of the principle of the roller bearing over a hundred years ago—an attempt which failed due to the aforementioned condition of the metallurgical and tool makers' art—we still turn both axle and wheel, and when we use roller bearings we know that for some still unknown, though suspected reason, the axle breaks at the race way.

A century ago it was developed that if you trained the exhaust up the stack you created a partial vacuum which created a draft, whereby you encouraged a fire. Today we are still wasting power through back pressure in the cylinders to create the induced draft in the engine, and we are yet in ignorance as to a method of regulating the exhaust to properly work the fire under varying conditions.

More than 20 years ago I suggested to my trainmaster that it might be well worthwhile to study springs. Acting on the suggestion, he wrote a large publishing house in New York for a list of books on the subject. In due time a list was received—"The Cure at Baden-Baden"; "Mauheim and its Famous Baths"; "Saratoga Spa"; "History of Underground Waters." Was this list a reflection on the lack of interest in mechanical springs? Perhaps, for even today we know but little about springs as applied. Though the direction of motion is both vertical and lateral, we have confined ourselves almost exclusively to the former and in that direction only in part with the result, most engines and cars ride badly. What is the life of springs? Guarantees are quoted in terms of years which means nothing, but no one knows how many miles the springs will run.

After the production of some number of miles, an engine must be given classified repairs, but between these so-called general shoppings, how much maintenance, time and effort, is devoted to the 17,000 parts of a locomotive? Why cannot all the parts run free from repair between main shoppings in the absence of accident?

### Car Problems

If we consider cars, we find somewhat similar conditions. We design channels and I-beams and needle beams of extra weight, that we may then extract part of the metal to afford opportunity to insert still other pieces of metal in the form of rivets. We place springs in trucks to resist the weight of gravitational thrust, but usually overlook the distinct discomfort of the recoil. The drawbar, as its name implies, was originally intended to link cars together, that they might be drawn in a group. Yet knowing this we still attempt to force a device, designed to pull, to absorb the shock of impact.

It was long ago discovered that if you had moving parts, some type of lubrication was necessary. To lubricate the journal we use the same method employed for the last 75 years and still the journals heat up and are either cut or the car is set out.

It may occur to you that I have given a picture that reflects but little credit upon my own profession; that I have pointed out too broadly in part, too detailed at other times, some of the questions in this transportation field. The questions asked or those implied are not propounded to belittle the achievements of the railroads. They have done and are doing a great work, and playing a large part in our industrial life. They are capable of the safest, fastest and cheapest transportation of persons and goods in the world. They have met every task set them; in the fair days of summer, in winter storms, in floods and other national disasters, in peace and war. They have established a reputation that no member of the profession need apologize for nor be ashamed of. But they have done it the hard way, hard for their patrons, perhaps, but harder for themselves.

They have restrictions and interference everywhere and adverse criticism; they have competition, regulation and taxation. All these make it difficult and are portions of the problems of the rails. But to me, above all these, they have these many unanswered questions, this great lack of basic fundamental knowledge, this thing which is attainable not through the effort to improve transportation specifically, nor the instrumentalities they use, but which requires that hardest and most honest of all work —pure scientific research. This is to me the real problem of the railroads.

## Four New Zephyrs For the Burlington

(*Continued from page 15*)

load. Equalizers, made of special steel, stood a drop test of 2,000 lb. from 54 ft. without rupture. Wear plates, provided where necessary in the truck design, are made of high-manganese carbon steel. The Bethlehem 36-in. heat-treated multiple-wear steel wheels have 1 in 40 straight taper treads, ground after application to the axles, which have the same general dimensions as the E-12 axle, with 6½-in. by 12-in. journals mounted in Timken roller bearings. The trucks are equipped with Simplex clasp brakes, there being four brake cylinders per truck, with Westinghouse automatic slack adjusters connected on each side of the truck so that a hand-brake equalizing lever placed at one end of the truck will apply the brakes on all of the wheels. There are two 18-in. brake shoes per wheel. Houdaille double-acting shock absorbers are installed on all trucks between the bolster and the truck transoms.

---

BELIEVE IT OR NOT.—Snakes have recently given two railroad men the scare of their lives. Southern Pacific Signalman Bill Gleason's motor car ran over a small tumble weed on the track and a big rattlesnake was thrown up around his neck in some unexplained manner. Alfred Naylor, a shop worker, sat down at home one evening to enjoy his radio, but it refused to work when he turned the switch. Looking inside, he saw what appeared to be a stocking wrapped around one of the tubes. When he tried to remove it he was bitten by a 36-in. bull snake. Next time his radio gets out of commission he is going to call Frank "Bring-'Em-Back-Alive" Buck to fix it.

# EDITORIALS

## Importance of Research

Comparatively simple and commonplace details frequently interfere with the most efficient performance and shorten the service life of a tool or piece of equipment. The railroads started from exceedingly crude beginnings; the proper tools and facilities to build a highly efficient locomotive or car were not available in the early part of the 19th Century and it was only by a slow process that it was possible to improve and refine in detail the facilities and equipment used in railroad operations. Fortunately, in spite of this slow progress, the railroads were responsible for the rapid development of this country and the relatively advanced economic welfare of its citizens over widespread areas.

In the past few decades we have come into a new era—mass production with its cheapening of products and great forward step in economic progress. New factors have entered into the field of transportation and the railroads have been forced to furnish a much better type of service than was even dreamed of in the late 90's. Today, they are fighting for their lives in competition with other forms of transportation, and under this stress are reaching out in a variety of ways and doing many things not only to improve their services, but at the same time to lower the costs of such services.

In doing this, however, they are only keeping pace with other wide-awake industries. Not a few corporations, for instance, have come out of the prolonged depression with flying colors, because of research, not only as to materials, designs and production processes, but also in the field of promotion and merchandising. The argument may be advanced that our cars and locomotives and the facilities for maintaining and repairing them are ample, or at least, that they are giving reasonably good service. Why, therefore, fuss about them?

The great difficulty is that so many of us are inclined to take things as we find them. We fail to progress because we do not stop to analyze and study details and problems which have become so commonplace that we allow them to pass by unchallenged and even unnoticed. The few who do cultivate the faculty of seeing these things have an exceedingly difficult time awakening the rest of us to a recognition of the shortcomings and the necessity for adopting new designs or new methods and practices. Here is where the scientific approach enters the picture. It questions everything and insists upon the use of trained specialists who can get to the very root of a problem, analyzing it in all its details and then finding ways and means of bringing about improvement.

J. T. Loree, vice-president and general manager of the Delaware & Hudson, in speaking before the New England Railroad Club, commented upon some of the commonplace things in railroad service and operation that we do not thoroughly understand and that should be subjected to intensive study, in order that more efficient equipment and facilities be provided. An article, elsewhere in this number, includes those parts of Mr. Loree's address that are of special interest to mechanical department officers and supervisors.

Fortunately the Association of American Railroads has recognized the need for engineering research, and L. W. Wallace, who is specially well equipped for the service, is director of equipment research. Excellent progress is being made in studying and analyzing a number of problems related to the mechanical department, the most important of which is air conditioning.

It is important that the railroad executives understand the full purport and value of such work and that no effort be neglected in supporting and stimulating it, so that early and adequate results may be available. It is true that the railroads and the railway supply companies have done a great amount of research, which has made it possible for them to reach their present advanced status and yet, as Colonel Loree pointed out in the article referred to, and as Mr. Wallace has continually emphasized, there is a vital and compelling need for more intensive, well organized, engineering research in the railroad field.

## Mechanical Supervisors And Public Opinion

As we see it, one of the primary obligations of railway mechanical department officers and supervisors in 1937 is to overlook no opportunity of supplementing their normal duties by helping to create a more favorable public opinion towards the time-tested institutions of this country and towards the railroads which are so essential to its prosperity.

Acute problems in human relations, as well as mechanics, confront the railroads in the New Year, and

the surprising thing is how many of these problems are not new but have been handed down from generation to generation. In the mechanical field, for example, men thought that they settled the question of taper versus cylindrical-tread tires over 50 years ago, but out it crops again in connection with light-weight high-speed trains. At least one important railroad in this country uses left lead steam locomotives, and, in all probability, few if any locomotive designers, even on this road, can explain how the practice originated and why it is still followed.

Similarly, in the field of human relations, difficult problems are particularly likely to recur. An aggressive minority is spreading the doctrine that there is no real equality of opportunity in this country and that all large corporations, including railroads, banks and other business enterprises are organized to oppress their employees and wring profit from the general public. Is this a new sentiment? Well, hardly! In 1838 Daniel Webster said in the United States Senate:

"There are persons who constantly clamor. They complain of oppression, speculation and pernicious influence of accumulated wealth. They cry out loudly against all banks and corporations, and all means by which small capitalists become united in order to produce important and beneficial results. They carry on mad hostility against all established institutions. They would choke the fountain of industry and dry all streams. In a country of unbounded liberty, they clamor against oppression. In a country of perfect equality, they would move heaven and earth against privilege and monopoly. In a country where property is more evenly divided than anywhere else, they rend the air shouting agrarian doctrines. In a country where wages of labor are high beyond parallel, they would teach the laborer he is but an oppressed slave.

"Sir, what can such men want? What do they mean? They can want nothing, sir, but to enjoy the fruits of other men's labor. They can mean nothing but disturbance and disorder, the diffusion of corrupt principles and the destruction of the moral sentiments and moral habits of society."

As good citizens mechanical-department officers and supervisors have a definite duty to combat this sort of propaganda, so wide spread now and so accurately described a century ago.

It is equally important to fight anti-railroad propaganda and, whenever opportunity offers, point out how closely national prosperity is tied up with railroad prosperity. A much more favorable public sentiment towards railroads has been achieved in recent years, but there is urgent need for still further improvement. In discussing this subject before the October meeting of the Western Railway Club, T. W. Evans, vice-president, New York Central, quoted from an editorial "Cultivating the Public" in the current issue of *Railway Mechanical Engineer* and said:

"On one hand we have the public demanding lower freight and passenger rates; on the other, the employees, through their representatives, are demanding higher wages, improved working conditions and, in addition, trying to have enacted such legislation as the six-hour day bill, train-limit bill, full-crew bill, track- and bridge-inspection bill, signal-device bill and train-dispatching bill, all of which, if enacted, would impose additional costs on railroad operation to the amount of 450 million dollars annually."

No one has yet discovered a way to "have his cake and eat it, too." The meagre earnings of most railroads, especially in the last few years, is a matter of public record. Many roads are now insolvent or facing bankruptcy. In numerous instances, necessary new equipment is being purchased with money secured from the national government because the credit of the railroads involved is not adequate to attract private capital. Probably few railroad officers are unsympathetic with the desire of the railroad brotherhoods for more jobs for railway men, but how, in the long run, they expect to attain this end by saddling railways with increased costs which will handicap them in competing with other forms of transportation and tend to drive traffic from the rails is something of a mystery. Mechanical-department supervisors, like supervisors in all other railroad departments, have a definite responsibility, insofar as possible, to bring a common-sense view of this situation to the attention of the rank-and-file of men who work for them.

## Pertinent Suggestions on Car Repair Billing

In one of the most interesting programs held during the past year, the Car Foremen's Association of Chicago devoted its December meeting to a discussion of car repair billing. The principal speaker, C. J. Hayes, manager A.A.R. clearing house, New York Central, Buffalo, N. Y., brought to the meeting a wealth of practical knowledge and experience with car-repair billing which was supplemented by that of other car men in attendance.

The magnitude of general car-repair billing and the great amounts of money involved are indicated by the fact that, on the New York Central alone, Mr. Hayes' bureau handles 1,100 incoming and outgoing bills a month, which involves checking and pricing 161,000 repair cards and aggregates a monthly billing of $625,000. Operations of this magnitude always suggest the possibility of economy by a critical study and analysis of just how the work is being done, and it was the concensus of the meeting that five specific suggestions, advanced by Mr. Hayes, were worthy of thorough investigation with a view to being recommended as improved billing practice.

The five recommendations, which are of general interest, are suggested by the following questions: (1)

In view of the conditions under which billing repair cards are being prepared in train yards and classification yards, both by day and night and sometimes under highly adverse weather conditions, would it be practicable to have settlement made for such repairs in some other way in order to lessen the hardship on car inspectors and car repair men? (2) In view of the large number of defect cards issued covering repairs and minor Rule-32 damage that are not being used for billing, also considering the number of days which elapse between the date of defect cards and the date of repairs, would it be practicable to reduce substantially the number of such cards issued in order to lessen inspectors' clerical work and thus give them more time to devote to inspection for safety? (3) Can the reason for the large difference of wheel renewals on account of cut journals on cars of different ownership be ascertained, also the feasibility of making cut journals a delivering-line responsibility instead of a car owners' responsibility? (4) In view of certain apparent unavoidable errors that are being made in the preparation of billing repair cards and the pricing of such cards, would it be practicable to consider a car-repair bill correct, as rendered, when 99.5 per cent correct, per thousand dollars billed, in order to lessen correspondence and investigation of small overcharges and undercharges? (5) In view of the majority of billing clerks devoting much of their time to checking car repair bills for correctness of car numbers, charges, and footings should not a certain portion of their time be devoted to analyzing both incoming and outgoing bills in order to eliminate the possibility of specializing in certain items of repairs?

The simplification of car-repair billing was the subject of an extended study by a sub-committee of the Arbitration Committee of the Mechanical Division following the discussion of the Arbitration Committee's report at the 1931 meeting of the Division. A summary of the final report of the sub-committee on its investigation of three propositions was included in the Arbitration Committee's report presented at the meeting of the Division last June. The propositions investigated were the establishment of central or regional clearing bureaus to replace the present method of cross-billing among the railways, the elimination of all billing for freight-car repairs and the elimination of billing for repairs as between railways only. It will be recalled that the conclusions of the committee were unfavorable to any of the three propositions because of disadvantages in the loss of checking control and in actual increases in expenses which more than offset the direct reduction in billing expense which might be effected.

A most interesting comparison in the report was that between the estimated economies to be effected by the establishment of a central billing bureau as of December, 1932, and December, 1934, within which period immediate economies estimated at $15,000 per year were changed to immediate losses of approximately $46,000 a year, a difference brought about by decreases in costs following the general discussion at the 1932 meeting. This improvement the committee attributed to improved methods and increased efficiency.

This report would seem to settle for some time to come all questions concerning the desirability of continuing the present system of car-repair billing. It does not, however, preclude the possibility of finding and eliminating wasteful practices in the administration of this system. Mr. Hayes' second and fourth suggestions are particularly worthy of consideration from this viewpoint.

## NEW BOOKS

WROUGHT IRON—ITS MANUFACTURE, CHARACTERISTICS, AND APPLICATIONS. *By James Aston and Edward B. Story. Published by A. M. Byers Company, Pittsburgh, Pa. 59 pages, 6 in. by 9 in., 29 illustrations. Price $1 but free copies may be had on request on letter-head of potential wrought iron users and faculties of engineering schools.*

The first two chapters of this small book contain a concise but rather complete history of early methods of manufacturing wrought iron and a discussion of a research made in 1915 for ascertaining the structural characteristics and chemical composition of specimens of good quality wrought iron made prior to that date. Chemical analyses and abbreviated service data on more than 50 of these specimens are included in the book. After pointing out how the early processes of manufacturing wrought iron limited the production of this material, and prevented physical uniformity of the finished product, the authors relate how the research made in 1915 resulted in forming the basis for the development of present-day methods for manufacturing wrought iron in quantity lots of uniform physical characteristics. Paralleling the discussion of production methods, the authors point out that the feature of wrought iron is a matrix of high purity iron embedded with thousands of fibrous ferrous-silicate threads. They then relate how other ductile ferrous materials were developed while attempting to produce one with resistant qualities similar to those possessed by wrought iron, and they present chemical analyses and microphotographs of the materials for comparison with those of wrought iron. The fifth chapter of the book contains a complete discussion of the physical properties, chemical analyses, and structural features of wrought iron as observed under macroscopic and microscopic examination. Chapter VI is devoted to a discussion of such characteristics of wrought iron as resistance to corrosion; resistance to fatigue fracture; adherence and weight of protective coatings; weldability; and forming, threading and machining. The remaining chapters of the book discuss the principal applications for wrought iron, itemizing these applications in diverse industries and fabrication processes. The book concludes with a glossary of terms relating to wrought-iron manufacture and products.

# THE READER'S PAGE

## "Old Fogey" Gets After Williams

To the Editor:

I can usually agree with the conclusions of most of the contributors to the *Railway Mechanical Engineer,* which is the most interesting and informative trade publication I can obtain.

But from a study of the several articles by F. H. Williams in recent issues, I am inclined to think these will become the cause of much needless and unwelcome grief and worry for many railroad men, who already have plenty of a kind they like to meet and remedy. But his "straining at gnats and swallowing camels" idea is questionable. Certainly, the study of the cause of fractures of certain locomotive parts is of great interest, and much valuable data may be secured in the shops for the steel manufacturer and the metallurgist.

Still it is almost as hopeless as it is ridiculous to line up the machine-shop foremen and the lathe operators and dramatically point to some tool mark or scratch and exclaim, "There is the cause of the fracture occurring to the main axle of engine so and so last month," when the same men know that, if such was the cause, scarcely an engine on any railroad would go six months without some part failing.

The steel men must look further than the machine shop for the real cause of their troubles and produce a metal such that a slight tool-mark scratch or indentation will not ruin a $150 axle. Practically every failure coming under my notice for the last 18 years has occurred where the part has been under great external compression, whether axles, crank pins or piston rods, the fracture occurring from one-half inch to one inch in from the inside face of the wheels, and about the same distance inside the largest diameter of crosshead fits. Whether the fractured section had been ground, polished, rolled, or showed slight file marks, legitimate lathe tool marks, or scratches, there was no noticeable difference in the break, nor in the mileage run before the fracture occurred. And my belief is that this pressure has something to do with the trouble.

To go about the modern day machine shop exhibiting the file marks on a metallurgist's watch (see page 483, November issue), insisting that better work be performed on axles and crank pins than was done on his watch, while attributing the cause of a broken crank pin to a lathe tool having either an incorrect cutting angle or having been improperly set seems rather far-fetched, especially when the photo submitted shows plainly that under the "microscope" the steel was of a very coarse structure and improperly annealed.

It would be a difficult matter to make a good machinist, such as is always used on the class of work in question, believe that if he had used a tool properly set up, carefully adjusted to the correct height for that "special material to be machined", the pin in question would not have broken.

No, Mr. Metallurgist, while we in the shop will go along with you and help you with our naked eyes to produce a metal that does not require to be machined under a microscope, and carefully wrapped up in woolen cloth while being handled at the press by careful men who must not wear rings on their fingers for fear the finished parts may be scratched thereby, we'll do our best with the finish on our radii, and be on the lookout for the first axle, crank pin, or piston rod to break at any of the radii we have already turned out on which scratches show.

I also believe that depending upon the roller to improve the conditions complained of is open to considerable debate. I have found where the roller was being depended on to eliminate scratches, but doubt if the job was improved by that method.

Old Fogey from Frisco.

## If I Could Build My Own Round House

To the Editor:

When any one mentions a modern roundhouse it instantly brings to mind a number of conveniences, well known and well advertised, which lighten the work and speed up the handling of engines. It is not my purpose to belittle in any way these splendid features. However, there are other factors to be kept in mind in a new layout which can make or break the most elaborate plan.

Take drainage, for example. Main line tracks and yards have a habit of creeping upward as years go by. The section men ballast a track here and raise a repair yard there to match it, but the roundhouse and turntable must stay at the same old elevation. After some 30 or 40 years the surrounding property is a couple of feet higher than the turntable pit. In the spring the rains wash over the walls and clog the sewers. In the winter ice forms about the roundhouse doors with dire results. How much better to have started the house a couple of feet high in the first place.

The track layout is too often left to the engineering department with a mania for stretching things out. I know of no reason for making an inbound track over 500 feet long except in rare cases. If the extra room must be had, build two cinder pit tracks. It will save much shoe leather for the foreman as well as the hostlers. The outbound trackage should have plenty of spurs for holding engines called and awaiting calls without having to juggle them around.

The turntable will cost the most of any individual item, and properly so. The best is none too good. It should be as long as the budget allows and three-point suspension, of course. But even the most expensive machinery avails naught when the electric power fails and an arrangement should be provided for operating with an air motor on short notice; this is slow but effective. The same holds true for the coal dock and cinder conveyor. Two forms of power should be furnished in case of interruption of electric service.

The roundhouse itself should have at least two tracks lined across the table from inbound and outbound tracks. These are for handling dead engines. The machine shop and storeroom should be near these tracks and as close to the center of the house as possible.

Now for the foreman's office, if any. Some mighty fine terminals have their foremen located clear back somewhere around the machine shop. No doubt that is a comfortable place to be in the winter, but there is more going on at the cinder pit. If he can see an engine when it comes in he can judge pretty well what its chances are on the return trip. Personally I believe the proper place for the roundhouse foreman is as close to the inbound track as possible. The dead work in the house will take care of itself, but when things happen on the pit or outbound tracks they happen fast.

J. E. Kloss.

*General Foreman, N. Y., C. & St. L. R.R.*

# Gleanings *from the* Editor's Mail

**The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.**

### Car Journal Lubrication

Why do railroad companies and car builders stick to the present method of car journal lubrication, which is about as crude as it was 50 or more years ago, while they have been constantly improving other car appliances?

### Lighting Facilities Inadequate

A clean shop is necessary in order to provide safe working conditions and a healthy atmosphere for the mechanics to work in, thereby producing better work; especially so if the lighting facilities are adequate. In many shops lighting of the machine bay is deficient and could be improved upon; this would not only mean a greater degree of safety for the employee, but also increased output.

### Take Advantage of Better Cutting Steels

Railroad shops are not keeping up with the times. The introduction of the new cutting tools has revolutionized shop methods, particularly in the last three years. It is not necessary that railroads purchase new single-purpose production machines; the present machines can be speeded up to the capacity of tools, such as Stellite, and if properly ground the capacity of machine can be more than doubled, the point being to get proper finish with one cut.

### Cranes For Each Machine

Another thing that I have had in the back of my head for some time is just this: If I were purchasing machine tools I would specify an individual crane for each machine. There is no way to estimate the time lost in waiting for overhead cranes to serve machines, especially in large shops. The overhead cranes should be used to place the material at the machines and take it away after it is finished. I have installed these individual cranes on several machines and these installations have proved a good investment.

### Obsolete Machines Costly

I often wonder how shops like the———, with all the old obsolete machinery, can possibly make any money. They have a lot of old driving wheel lathes in their wheel shop; two or three modern wheel lathes will do as much work as all the 12 or 15 machines they have will do. You can take the average railroad or locomotive builders' plants and throw away over half of the old, worn-out machines and install one-fourth the number of good, up-to-date machines and increase production about 25 per cent. We see crossheads being planed on old, slow-motion planers. They may turn out six or eight per day, but an up-to-date milling machine will mill these at the rate of two per hour and use only about one-fourth as much floor space.

### Safety Signs

As to "signs of safety" I think Walt Wyre has put forth a lot of good food for thought. It is an old saying, and I believe a true one, that "familiarity breeds contempt," and merely posting a lot of safety signs is not going to promote safety, as these signs soon become so familiar that the men pay little attention to them. I think that the best method of promoting safety is for the supervisors, through personal contacts with the workers, to convince them that they are personally as much responsible for getting hurt as they are responsible for putting up a bad job, and I usually have found where those points are driven home they have a pretty good safety record.

### When Basford Was Editor

I can remember, way back when I first started railroading in 1903, that I found located in various places throughout the offices, loose copies of the American Engineer and Railroad Journal (now *Railway Mechanical Engineer*) from dates of 1896 to 1901. These papers contained a wealth of information which to me at that time was priceless, and I still have the clippings removed from these early magazines. Quoting from memory, they contained articles by Cole, Grafstrom, Henderson, Forsyth, Mellin, Pomeroy, Quayle, Goss, Vaughan and Vauclain, and of particular value was a series of articles on locomotive design and construction by Mr. Cole. Strange to say, these articles, although written over 30 years ago, contain considerable data suitable for present-day use. Of course, at that time we were in a more formative stage than we are now, and many matters could be written about which are now accepted as commonplace.

### Concerning Engine Failures

Mr. Williams' suggestions and findings in his articles on engine failures are in line with recommendations that have been made by our own laboratory people. More and more as our trains are speeded up, we have found it necessary to tighten up, not only on the quality of the material used, but also on the methods of handling, and we are constantly consulting with our mechanical engineer's office and the laboratory as to what may be done to improve the performance. In addition to all of this, we call a monthly staff meeting of all master mechanics, where each engine failure is thoroughly discussed and a decision reached, as nearly as possible, as to what caused the trouble. A report of this meeting is then mimeographed and every foreman on the railroad, no matter how small the terminal, is furnished a copy of this analysis of our engine and motor-car troubles, in order that everyone may get the benefit of these meetings.

### Efficient Handling of Portable Tools

Several years ago when we were about as busy here as any shop in the country and were doing as much work as any shop of its size, we discovered that a lot of time was lost in getting portable tools ready for a job—boring bars, facing machines, portable grinding and milling machines, valve-seat facing machines, and other tools. The parts were scattered all over the shop and it took longer to find the tools and put them in shape than it took to do the job. Here's our solution. We built six or eight special trucks; we mounted the large cylinder boring bar on one truck and attached a steel box to the rear of it; in this box we put all the small tools, wrenches, clamps, etc. The tool-room foreman had a key to the box, as did the erecting-shop foreman. When the boring bar was removed from the cylinder and put back on the truck, it was sent to the tool room and the tool room foreman had the bar inspected, all repairs necessary made and the truck placed in a building where it was parked until needed. We have two large roundhouses and an erecting shop here; whenever any of the portable tools are needed the foreman in charge simply calls the truck dispatcher and tells him to take the cylinder boring bar to the place designated and the bar is placed at the engine where the work is to be done, with motor and all equipment ready to do the job. Compare this with the old method and see how much time is saved. I wonder how other shops handle this proposition.

# With the Car Foremen and Inspectors

## Gaging Cast-Iron Wheels*

*By H. B. Atherton*

Inasmuch as the A.A.R. rules do not permit us to remove a wheel from a foreign car and render the bill against the car owner until some defect has developed to a definite point, we must assume that the wheel is perfectly safe until that point is reached. Therefore it seems reasonable to assume that the wheel is still safe even when that point has actually been reached.

Now I do not advocate permitting any wheel to remain in service with any defect that has reached the condemning limit, but am merely bringing out that point because when we remove a wheel because some defect is "awfully close" to the limit, we are throwing away service because it requires 5,000 miles to wear 1/64 in. from the wheel.

There has been a tendency for a number of years to eliminate from the rules the so-called "judgment defects," and measuring devices have been developed to tell us when a wheel should be removed; but in spite of this, I believe that the inspection of wheels is the most particular job a car inspector has to do.

Car inspectors as a class are, in my opinion, among the most conscientious employees of the railroad. They realize their responsibility and endeavor to protect their railroad against accidents and at the same time prevent unnecessary delays to shipments, but it is possible that at times some of them may be a little technical when inspecting a bad-looking wheel and, to play safe, card it to the repair track where it can be inspected under better conditions. If the wheel is actually questionable this, of course, is the proper thing to do; but if it is a case of improper gaging, it is decidedly wrong, because the time consumed in moving a car to and from the repair track usually causes it to miss schedule, often resulting in a dissatisfied shipper, to say nothing of the switching cost involved, which averages about $4.

Wheels account for the heaviest single item of expense in connection with car repairs and too much attention cannot be paid to this matter.

*Rule 68.*—This rule provides that flat sliding wheels should not be removed until one spot at least 2½ in. in length or two or more adjoining spots, each 2 in. or over in length, have developed. In gaging slid spots, the gage should be placed on the spot parallel with the flange and not turned to cover the spot cornerwise. The length of the spot must be considered as running parallel with the flange and must be of the limiting length in this direction, even though it may be in excess of the limiting dimension when measured at right angles with the flange. It will be noted that where two or more 2 in. spots have developed, at least two of them must be in contact with each other. Slid spots are caused by raising the temperature of the tread to about 2,000 deg. due to friction on the rail when the wheel stops turning, and a spot ¾ in. by 1 in. can be put on a wheel in about 10 ft. under capacity load. A spot this size removes 1.1 lb. from a wheel under a 50-ton car.

*Rule 71.*—The same method of gaging shelled-out spots, of course, is to be followed, as in gaging slid spots, but care should be used to distinguish between shelled spots and brake burn, the former having somewhat the appearance of an oyster shell, while the latter is made up of a number of cracks close together running crosswise of the tread.

*Rule 72.*—Seams as defined in Rule 72 are probably the most dangerous defects of all, and when any seam is discovered within 3-¾ in. of the flange, the wheel should be removed from service.

*Rule 73.*—Worn-through chill spots are found in wheels of low or shallow chill. When the chilled metal wears through, the softer metal underneath shows a gray, mottled color. If the tread has flattened, it can be determined by drawing a straight-edged piece of metal along the tread with one end of it in contact with the flange and the mark on the wheel left by the piece of metal will show a bow or arc.

*Rule 74.*—Under wet weather conditions it is sometimes difficult to determine whether a vertical flange has reached the condemning limit, and the easiest way that I know of to determine this is to use ordinary soft white chalk to whiten the worn surface of the flange. Then place the gage upright in the proper manner and move it a short distance along the flange. If the indicating point on the gage does not leave a mark in the chalked surface of the flange, the wheel should not be removed, even though the destination of the car is 1,000 miles or more away. Care should be used in applying the gage to thin flanges to be sure that it is not tilted but is held as level as possible.

*Rule 75.*—Brake-burned wheels are caused by raising the temperature of the tread about 1,400 deg. and are often caused by conditions beyond the control of the car department; but a defective triple, or retainer, or a set handbrake can accomplish this in less than half a mile. These same causes can also slide a wheel; so it is therefore of the greatest importance to know that the air brakes are working properly and that there are no handbrakes set on cars leaving terminals; and trainmen should know that brakes are released on cars picked up at way stations. The same method of gaging applies, as in the case of slid flat wheels, except that care should be used to determine whether any cracks over 2-¾ in. have developed or any cracks are in the flange or throat.

*Rule 76.*—Figure 4-D, Rule 76, shows the proper

(*Continued on page 38*)

* Abstract of a paper presented at the November meeting of the Chicago Car Foremen's Association. Mr. Atherton is car foreman of the Chicago Great Western at Chicago.

# CAR FOREMEN Have Tr

DICK WHEELER, car foreman for the S. P. & W. at Plainville, stamped his feet on the door sill to shake off the snow. When he opened the office door the little room seemed colder than it was outside despite the fact that heavy, black smoke was pouring from the chimney on top of the office. Wheeler opened the caboose stove door. Just as he expected, a heavy wad of old packing, weighted down with a layer of coal, was smouldering in the stove.

"Might be a good way to smoke out mosquitoes, but a damn poor way to build a fire!" Dick commented as he gave the waste air by lifting it with a packing hook that served as a poker.

After some manipulation and coaxing, the fire gave signs of coming to life. The car foreman sat down at his desk to look over the mail before time for the men to start to work. As he read the letters, he began to frown, frowning more as he read: "—entirely too much overtime, too many hot boxes, too much delay getting trains through the terminals, too much car oil being used. No excuse for the steam heat line freezing up on the Limited. Twelve stock cars needed immediately—"

Wheeler finished the mail, glanced over the latest lineup, and went over to take another poke at the fire in the caboose stove. "Too much car oil!" he snorted, "and the packing so dry it won't burn! No wonder we have hot boxes!"

"What seems to be troubling you?" Ed Williams, the yard clerk, asked as he came in to warm his hands.

"Oh, just doing a little private bellyaching. They keep hollering about too much oil and too many hot boxes. Why, there's not enough oil in a handful of the packing we get to make a greasy spot on a white shirt!"

"Yeah, they're never satisfied," Williams replied.

"I don't mind getting et up if I'm at fault," Wheeler replied, "but the master mechanic give me a trimmin' over the steam heat being froze up on the Limited night before last, when he knows it came in froze up. It's not my fault if the train crew goes to sleep on the job. Then when I work a couple of men an extra hour to get the train out with as little delay as possible, I catch thunder —too much overtime!"

"Well, I've heard there would be days like that," Williams consoled as he left.

Wheeler took a turn around the rip to see what had accumulated the night before. A wooden gondola with the draw-bar yanked out, a couple of automobile cars with wheels to be changed, a caboose calling for weather stripping of doors and windows, and a miscellaneous collection of others needing everything from brake beams to deck, siding and roof. A reefer on number three track was squatting slightly on the left side of the A end. Dick knew without reading the card it was a broken arch bar.

As he circled back to the office, the car foreman mentally assigned men to the various jobs.

AT eight o'clock the carmen and their helpers trudged out in the snow to their various jobs. Two or three more fortunate than the rest caught jobs in the car shed where the snow only lay in patches. The flock of sparrows that used the place as shelter made it inadvisable for a person to have his mouth open when he looked up. Tom Blake, who served in the army during the World War, said if the Allies' bombers had been as accurate as those sparrows the war would have ended six months sooner.

Jake Miller and his helper went to work replacing the broken arch bar on the reefer. At least that was their intention. The first hour they put in locating a jack that would work and wasn't in use. The car foreman

# ve Troubles Too

**by Walt Wyre**

**Whoever nicknamed carmen "dusty butts" should try a little of this! Thompson replied as he brushed the wet snow from his nethermost extremity**

came by as they were setting the jack under the car.

"Trainmaster just called. They're in a helluva rush for this car. Want to get it on 72," Wheeler said.

"Yeah, you might tell him he would speed things up more by getting a couple of new jacks than he will sittin' on his fanny and yellin'," Jake replied.

"I'll write the master mechanic about getting some of our jacks sent in for repairs," Wheeler told the carmen.

EVERYTHING seemed to be going as well as could be expected on the rip. Wheeler went back to the office to work on reports. He had just settled down when the phone rang.

"Have to have two more cabooses; one for a work train and another for an east turn," the trainmaster told him.

"The only two extra cabooses we've got are a couple of old wooden ones that need a lot of work before they'll be fit for service," the car foreman told him.

"Can't help that; we've got to have them."

"One of them will have to have a new end sill, and—" A click in the phone told Wheeler that the trainmaster had hung up.

The car foreman again waded out in the snow. He

went over to where Bill Thompson and Art Horton were working on stock cars. Thompson was sitting in the snow working on a brake beam.

"How you coming?" Dick asked.

"O.K. I guess; but whoever nicknamed carmen 'dusty butts' should try a little of this!" Thompson replied as he brushed the wet snow from his nethermost extremity.

"Let this go and put a new end sill in the crummy on No. 2."

"That Noah's ark? I thought it was set aside. Where am I going to get the end sill?" Thompson asked.

"Have to make it, I guess," the foreman replied as he started over to tell Horton to start work on the other caboose.

WHEELER went back to the office and again started to work on his reports. Again the phone interrupted.

"How you coming on that reefer?" the dispatcher wanted to know.

"I'll see—"

"We want to get it on 72 without fail. It's loaded with lettuce, you know," the dispatcher reminded.

"Yes, I know. I'll push it," Wheeler replied.

The car foreman found Miller and his helper at the blacksmith shop waiting for the blacksmith to make the arch bar. The broken one lay on the floor, a length of iron for the new one lying beside it.

"What's the delay?" Wheeler asked.

"Had a lot of work for locomotives," the blacksmith replied. "Be another hour before I can get on that arch bar unless the roundhouse foreman says different."

Wheeler located Jim Evans, the roundhouse foreman, and persuaded him that the arch bar was just as important as some of the other work, but lost twenty minutes doing it. It was almost noon when the arch bar was finished and ready to be drilled.

Miller and his helper carried the arch bar down to the car-department mill to drill it. The carman was willing, but the drill wasn't. The clutch wouldn't hold at low speed and the machine ran too fast in high. Wheeler came in while they were trying to drill the arch bar. He stood and watched a moment.

"Can't you make it work?" Wheeler asked.

"No," Miller said. "If the blasted drill hadn't been worn out, they wouldn't have given it to the car department in the first place. They'd have kept it at the roundhouse."

"Try it in high speed," the foreman suggested.

"It runs too fast," the carman said as he shoved the lever over.

"Keep plenty of soapsuds on it. Maybe the drill won't burn up," Wheeler advised.

The drill bit into the iron with a chatter as the point took hold. The shavings flew; then, as the lip of the bit dug in, it stopped. The belt was slipping. After fifteen minutes spent trying to persuade the antediluvian machine to function, the car foreman gave up. "Take the blasted thing to the machine shop."

"The drill-press man is snowed under. I looked before I brought the arch bar down here," the carman said.

"Well, tell Evans I said to have him drill it noon hour," the foreman replied. "You fellows had better stay with it and get it put on. The dispatcher will have epilepsy and the trainmaster too if we don't get that car finished in time to go on 72."

The twelve o'clock whistle blew before Wheeler reached the office. He called the dispatcher to get the latest dope on when the eastbound Limited would arrive. The dispatcher told him about 1:15, forty minutes late that made it.

"Hope it's not hot boxes on the cars," Wheeler reflected as he wrestled out of his heavy sheep-lined coat.

THE Limited pulled in at 1:35, and it was hot boxes that had caused the delay. Wads of frozen packing blossomed from around the lids of several boxes. The acrid odor of hot car oil assailed the car foreman's nose.

The two car inspectors got busy as a barefoot boy in an ant bed when the train slid to a stop. Wheeler grabbed a packing hook and pitched in. Three boxes had to be repacked. The trainmaster, superintendent, master mechanic, and conductor took turns making suggestions. The conductor looked at his watch every fifteen seconds, always holding it so the superintendent couldn't help seeing it. About the time the car foreman and the inspectors reached the tenth car, the chief dispatcher joined the audience. He had a watch, too. In fact, the proceedings were well watched and well timed, even if some of the offside remarks weren't. The train had lost seven more minutes over and above its regular dead time in Plainville when the conductor raised his hand.

"How you getting along on those cabooses?" the dispatcher asked when the Limited was on its way.

"Oh, pretty well, I guess. It's going to take a lot of time to make an end sill with the facilities we have," Wheeler replied.

"You've got a power saw and drill press," the master mechanic reminded.

"Yeah, both of them worth their weight for scrap. That's where they must have been headed when they were diverted here." Wheeler said it in a manner obviously intended to be joking, but it was equally evident that he meant it.

"We've got to have those cabooses tomorrow," the trainmaster chipped in as the car foreman started back towards the rip.

The first thing the foreman did after getting back to the rip was go to the mill to see how Thompson was getting along with the end sill for the caboose. The carman wasn't doing so well or rather the saw wasn't, which amounted to the same thing. Thompson was attempting to rip the heavy timber on the antiquated rip saw. The old saw had other ideas. First, the belt slipped; belt dressing helped some, but not enough to make the saw operate. The carman cut a piece out of the belt.

When Wheeler came in the mill he found Thompson sweating and swearing. He had sawn about one-third of the length of the timber by cutting a little way, then stopping and cutting some more. The saw mandrel was sprung, causing the saw to wobble so much that the cut looked as though it might have been made with a plow plane.

Wheeler heard the high-pitched whine of the saw before he entered the mill room door. The note became lower and lower, changed from a whine to a harsh rasping sound that ended with a grunt as the saw stalled in the timber and the belt came off the pulley.

"Maybe the saw hasn't got the right set," Thompson's helper suggested.

"I know damned well it hasn't. It should be set in a junk yard some place. Shut off the motor and put the belt back and we'll gouge another nick." The carman was exasperated.

Wheeler came in just as the saw stopped. He looked the situation over and left without saying anything. He did make a mental note to invite each of the division officials in to look over the obsolete machinery and suggest how he could be expected to do a decent job with it. Perhaps a demonstration would accomplish what letters had failed to do.

On the way back to the office Wheeler met Dint Robinson, a car inspector. "Stock car got to have a pair of wheels changed," the inspector panted.

"Well, card it and the switch engine will set it in the rip."

"That's just the trouble," the inspector said. "The switch engine ain't working and the car is already set to load."

"Can't they load another car?" Wheeler asked.

"Ain't no other car. They're figuring on starting to load about 6:30. The cattle are getting out on an extra at nine o'clock."

The car foreman pondered the situation for a moment. The switch engine tied up at two o'clock and wouldn't be back on again until eight. That would be too late to set in another car at the stock yard. "What's the matter with the wheels?"

"Chunk broken out of the flange. It's a C. T. & W. car. Came in over the interchange with that bunch last night," the inspector told him.

Wheeler groaned. "That helps a lot. Is the car setting so we could get to it to change the wheels there?"

"Yes, it's the last car on the east end of the stock-yard track at the chute. The bum wheel is on the east end of the car, too," the inspector added.

"O.K., I'll see if we've got a pair of wheels. As you go back, stop at the car shed and tell Wilson and Monroe to load a couple of jacks and some tools on a push car. I'll start a couple of laborers over with the pair of wheels."

There was a pair of wheels at the storeroom. Two laborers set out rolling them up the north passing track. The carman followed with a push car loaded with the necessary tools. Wheeler decided to take another whirl at making out his reports and answering some of his correspondence. He worked perhaps twenty minutes when Tom Blake came in, a journal brass in his hand.

"What's the trouble now?" the foreman asked.

"This brass," Blake said, "Look at it."

Wheeler looked. The babbitt, brand new as far as service was concerned, was battered and dented. One spot in particular showed a deep triangular dent. "Better get another."

"They've only got one more of this size in the storeroom," Blake replied, "and it's worse."

"Must be in pretty bad shape then. I can't see why the store department don't do something to prevent damage to brasses in handling. I'm going to write it up again."

"What do you want me to do with this one?" the carman wanted to know.

"Smooth it up the best you can and use it," Wheeler told him and turned to his office work.

When five o'clock came, Wheeler was still two-fingering the battered typewriter, working on reports. The correspondence was still waiting together with some left over from preceding days. Most of it would have to wait until Sunday to be answered while he was resting.

The car foreman finished the report on which he was working and decided to go to the stock yard and see how the boys were getting along with the pair of wheels. On the way he stopped at the mill to see about the caboose end sill.

The sill was there ready to be drilled. The piece of timber sawed from the sill told why progress had been so slow. At least half the length of the timber had been sawed by hand. Jagged places, burned spots, and saw marks told the story of numerous starts and as many stops before the carman had finally given up and resorted to hand power to rip the heavy timber.

At the stock-yard Wheeler found the work progressing fairly well. The boys had removed the bad pair of wheels and rolled them to one side so the new pair could be rolled in place.

"More overtime to be explained," Wheeler reflected. "Roll the old pair of wheels out where no one will stumble over them and leave them till morning. And be sure the packing is in good shape on these." The foreman indicated the pair of wheels being put in.

"You look kinda tired," Mrs. Wheeler said when the car foreman got home. "Have a hard day?"

"Oh, not so bad," Wheeler replied. "Supper ready?" he added.

"Just about. It'll be ready by the time you can shave," his wife replied.

"What's the idea wanting me to shave?"

"Oh, I thought we might go to the picture show," Mrs. Wheeler replied. "Wouldn't you like to go?"

"You and the kids go ahead," he replied. "I've got to go back to the office and finish my reports. Want to write a couple of letters, too."

"It'll do you good to go to the show. Can't the reports and letters wait until tomorrow?"

"Afraid not," Wheeler replied, "you see, the reports were due day before yesterday and I want to write the letters while they're fresh on my mind. I'm getting fed up on the car department being used as a dumping ground for machinery worn out by the mechanical department. I wish I had a sound picture of Thompson trying to rip that piece of timber this afternoon to send along with it," Wheeler laughed.

"It wouldn't be very funny to me," his wife cut in.

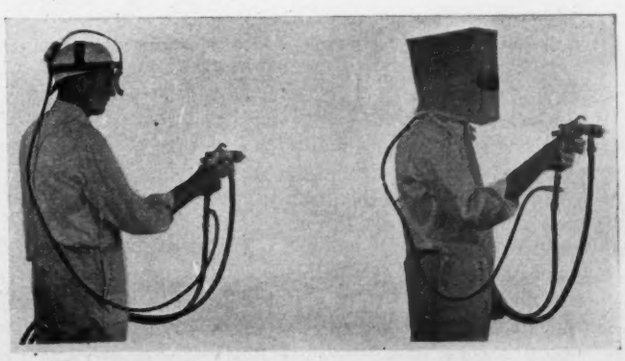
"Might as well laugh as cry. There are two kinds of foreman that stick on the railroad. One does the best job possible, catches hell for it, and likes it. The other does the best job possible, catches hell for it, and don't like it."

"Well, I wouldn't like it," his wife said, "and I don't understand why you don't go to the show and forget it."

"No, not being a car foreman, you wouldn't understand," Wheeler replied. "Pass the biscuits."

## Respirator Hood Without Vision Glass

A hood respirator designed for use in occupations where there is a fume or dust hazard which demands protection beyond that offered by the more common type of respirator, has been developed by The DeVilbiss Company, Toledo, Ohio. This respirator, designated by DeVilbiss as the type MPH respirator, covers the head and



**Air introduced into hood respirator flows out through vision opening and eliminates need for vision glass**

neck fully, and provides protection where ventilation is inadequate or against materials present in the air harmful to eyes, ears, or respiratory organs.

Air flows into the hood through a filter and flows out through the opening provided for vision, thus preventing outside atmosphere from approaching the eyes or entering the hood. Therefore, clear vision is provided with safety without the use of glass or other transparent material over the vision opening. The unit is composed of a lightweight headgear, air filter and air hose which is connected to the air line with a detachable connection, and a light-weight sanitary flame-proofed hood which is supported by the headgear. The hood, which is fastened around the neck by a draw string, is inexpensive and may be removed and replaced by a new one when it becomes soiled. The respirator is recommended for use in atmospheres containing offensive chemicals, nauseating vapors, particles of lint, paint spray, dirt or dust.

## Lubrication Correction

A specially treated oil, known as Lubco, is now being introduced in railway service by the Lubco Corporation, Chicago, for use as a lubrication correction for hot boxes and new brasses. This new processed oil is said to lubricate railway car journals regardless of waste grabs or foreign material present in the box, clinging to the journals and brasses under all conditions of service. Scientific tests indicate that, by the use of the new oil, journal friction is substantially reduced, capillary action in wool and cotton waste increased and corrosive action reduced. Lubco is not a cooling compound, but a corrector of faulty lubrication conditions.

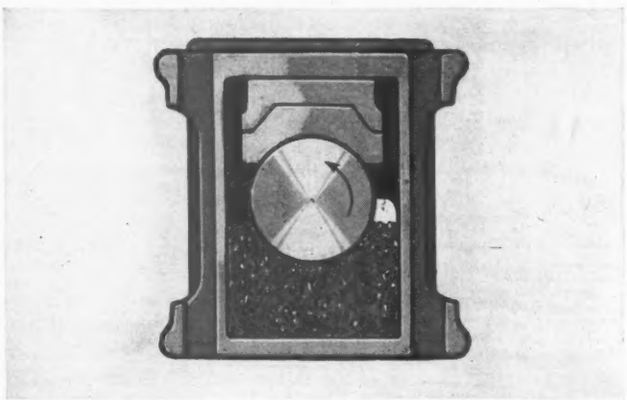
Lubco Hy-ball, particularly specified for the correction of hot boxes, is available in a handy kit, consisting of six emergency tubes of the processed oil, contained

**Lubco Hy-ball train kit which may be applied on caboose-car walls or at any other convenient location**

in a cardboard carton which may be kept on caboose-car walls, switch-shanty walls or wherever is most convenient for trainmen and car men. Advantages of this new lubricant include the conditioning of hot car journals so that they can be continued to servicing points without delay; elimination of delay and expense for setting out cars; avoidance of the necessity of service enroute when applied to new journals and brasses; reduction of friction, heat generated and power requirements; and the ability of the oil to maintain a film on the bearings in the face of heat, wiping or washing action and heavy loads.

When using Lubco in connection with hot boxes, the waste is cut back on both sides of the journal, the contents of the tube of Lubco being squeezed into the journal box near the rising side of the journal. With a packing iron or stick, the lubricant is forced as far back and as near the journal as possible, endeavoring to bring it in contact with the journal. No water or ice should be put in the journal box as this will only tend to flood the oil out of the box and contaminate the packing. Free oil may be added if necessary.

In connection with new applications, the brass is cleaned and the journal is washed with free oil. A light



**Cross-section showing application of Lubco Hy-ball on the packing against the rising side of the journal**

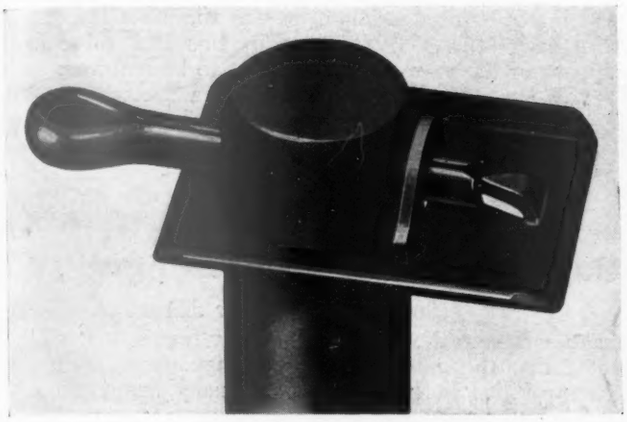
coating of Lubco is applied to the face of the brass and a small amount of oil added to the coating. The box is packed in the usual manner, adding about one-half the contents of a tube of Lubco to the packing as the latter is being applied. The balance of the tube is applied along both sides of the journal on top of the packing, applying free oil, if necessary, in the usual manner.

Lubco Hy-ball is available for the correction of faulty locomotive crank pin, guide, journal, valve and cylinder lubrication.

## Perfection Cotter Lock and Guard

That the failure of such an apparently insignificant part as a cotter key presents possibilities of hazards and in fact actual derailments of railway equipment is not open to question. Cotters which are insufficiently spread have a tendency to vibrate and work out and excessively spread cotters may fracture and break off. With greatly increased operating speeds, railway equipment parts are subjected to more severe vibration than formerly and, in the case of cotters or split keys, end thrust and friction tend to shear and wear them off.

To meet these conditions the Illinois Railway Equipment Company, Railway Exchange Building, Chicago, has recently developed and placed on the market a Perfection cotter lock and guard which is shown in the illustration. This device consists of a simple stamping made of No. 10 cold-rolled steel, having a hole in one end to fit over the pin, a small vertical ange bearing against one side of the pin and drilled with a hole corresponding to the cotter hole and a raised triangular projection which splits the cotter as it is driven home. This construction definitely spreads and locks the cotter in a positive manner. The cotter and guard act as a



Method of applying Perfection cotter lock and guard

unit, wear being taken on the latter and the cotter protected against abrasion and failure. The cotter is easily revolved and reapplied.

The Perfection cotter lock and guard is available for all A.A.R. standard pin sizes and is recommended for all pins on new car construction as well as repair work.

## Armco Galvanized Paintgrip Sheets

Commercial production of a galvanized sheet which is said to assure a good paint bond on iron and steel products has been announced by The American Rolling Mill Company, Middletown, Ohio. The product, introduced as Armco galvanized Paintgrip sheets, is the result of several years' research on the part of Armco's metallurgists and the technicians of the Parker Rust-Proof Company. It can be painted without special treatment of the surface.

The sheets are chemically treated to produce a finely crystalline phosphate coating which in itself is neutral to paint (being neither acid nor alkaline) and keeps the paint from direct contact with the zinc surface. This coating is an integral part of the sheet and is slightly granular in nature.

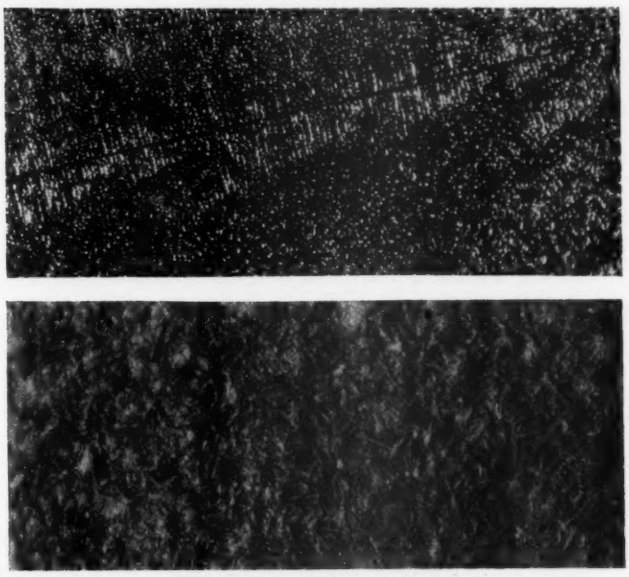
Armco Paintgrip sheets are available in any of the grades of galvanized sheets manufactured by the company. Analysis of the base metal can be that of Armco Ingot Iron, plain or copper-bearing steel. When it is required, all grades of these sheets can be supplied stretcher leveled.

Forming qualities of Armco Paintgrip sheets are the same as untreated galvanized sheets. They may be soldered with the use of hydrochloric acid as a flux. So-called "cut-acid" is not strong enough to penetrate the paint-grip film, which must be dissolved before a good solder bond can be obtained.

While Paintgrip sheets shipped from the company's mills are prepared to receive paint without further treatment, handling and fabricating operations in customers' plants will often necessitate cleaning. Organic cleaners such as naphtha, benzine and lacquer thinners are preferred. If alkaline cleaners are used, the paint-grip surface will be attacked and partly removed by their action. Because of its crystalline absorbent nature, the surface of a paint-grip sheet will tend to absorb a certain amount of the alkalies which are difficult to remove. Alkaline conditions under a coat of paint are considered one of the most common causes of early paint failure.

Practically any good paint can be applied to Armco Paintgrip sheets. If baked finishes are used, the paint manufacturer usually recommends a suitable primer. Any good baking system will be found satisfactory for Paintgrip sheets, provided the baking temperature does not exceed 450 deg. F. Higher temperatures are apt to be detrimental, particularly if the time of baking exceeds 15 min.

Formation of a paint-grip coating on metal is dependent upon the fact that phosphoric acid solutions



Above: Ordinary galvanized sheet—Below: Armco galvanized Paintgrip sheet. Magnification 40-diameters

will dissolve zinc phosphate within certain definite limits. Passing zinc-coated iron or steel products through such a solution results in the formation of the paint-grip coating which becomes an integral part of the metal surface at the point of solution. Reaction takes place with the evolution of hydrogen, continuing until the metal surface is completely converted to a crystalline phosphate coating.

## Low Capacity Air-Regulator

A low-capacity regulator, designed for the sensitive regulation of air pressures below 30 lb. has been developed by the DeVilbiss Company, Toledo, Ohio. This unit, designated as the type HFS regulator, has a diaphragm 4 in. in diameter for providing a sensitivity

DeVilbiss regulator for air pressures below 30 lb.

approximately six times as great as that of the standard DeVilbiss regulator, the effective diaphragm diameter of which is generally only 1½ in.

Regulated air pressure on the type HFS regulator can be graduated up to 30 lb. with but 1 oz. variation for each 10-lb. variation of main-line pressure. That is, a variance of 40 lb. in main-line pressure will cause only 4 oz. variation in the regulated air pressure.

The diaphragm is clamped in the regulator body between two brass castings fastened together by radially spaced bolts. Special valve design and construction prevent the valve seat from cutting into the rubber valve.

## Reseating Tool

Reseating tool No. 475 has recently been developed and placed on the market by the Foster-Johnson Reamer Company, Elkhart, Ind., for use in reconditioning the diaphragm portion of airhead governors. The operations performed with this tool include facing the diaphragm shoulder, facing the shoulder for the needle valve seat and facing the needle valve seat.

As shown in the illustration, the tool consists of a main reamer guiding portion with a knurled exterior

Combination reseating tool effectively used in air brake repairs

surface which may be used to turn the threaded end firmly into the diaphragm portion and against a shoulder which accurately positions the tool. The other knurled portion of the tool is designed to provide hand feed for the reamer, which is turned by means of a wrench applied to the upper square end of the tool.

The reamer proper is a combination tool which faces the flat portion where the diaphragm and needle valve rest, maintaining the correct vertical distance from both shoulders. The tool also faces the angle of the valve seat in the same operation, leaving the seats concentric with each other. By the use of this tool subsequent lapping of the valve seat is said not to be required.

The No. 475 reseating tool, with a special No. 601 spanner wrench, is available for use in reconditioning 1-in., 1¼-in. and 1½-in. governor diaphragm bodies.

## Gaging Cast-Iron Wheels

(*Continued from page 31*)

manner of gaging wheels with hollow treads. It will be noted that the index line on the gage must be on the center of the flange, which can usually be determined by a raised comby line.

*Rule 78.*—This rule clearly defines the method of measuring broken rims and only ordinary care is necessary to gage this defect properly. However, good judgment should be used in shopping loaded cars for this defect if close to their destination. Under favorable conditions, a cast-iron wheel should wear off 7/16 in. and give well over 100,000 miles of service, but largely due to such defects as slid flat spots and brake burns, the average wear from the tread is only ¼ in., therefore it is of the greatest importance to maintain the brakes in the best possible condition.

*Rule 82.*—While the use of the remount gages does not concern our car inspectors in their every day duties, it might be of interest to mention them. Remount gages must not be used to condemn a wheel in service, but are for the purpose of determining whether a wheel, the mate for which has been condemned, has sufficient service remaining in it to justify the expense of remounting at the wheel house. These gages are designed to scrap a wheel with such defects as worn flanges and hollow treads, when they reach a point ⅛ in. above the actual condemning limit, shelled-out spots 1-in. in length or width, brake-burned spots having a continuous cavity of 1 in. in length and brake-burn cracks 2 in. in length, also condemns a wheel for remounting. The manner of application of the remount gages is substantially the same as that of the gages used by car inspectors.

* * *

Paraffin base liquid painted over the glass before the exterior of the car is spray painted obviates the use of a masking shield—After painting is complete the masking coat is scraped off the window with a putty knife, to remove paint splashed on the outer surface

# IN THE BACK SHOP AND ENGINEHOUSE

## Interesting Method for Laying Out Shoes and Wedges

The method of laying out shoes and wedges described herein is that which has been in use for some time at the West Albany shops of the New York Central. The method is based on placing two straight edges parallel to an imaginary horizontal center line between the engine frames. Before proceeding with the actual laying out of the shoes and wedges, the engine-truck center casting and trailer-truck radius-pin center, if any, should be checked to ascertain if they are central between the frames.

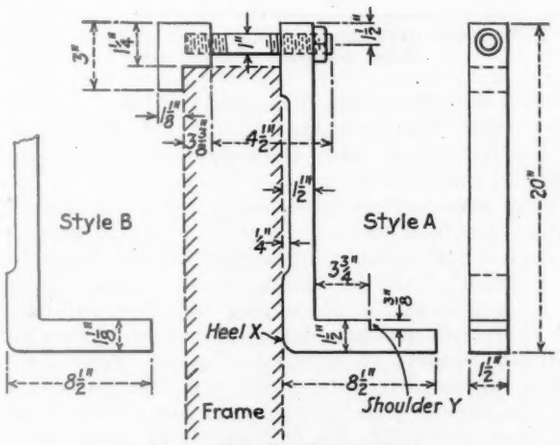



Fig. 1—Straight edge supports

The Style A straight-edge supports, shown in Fig. 1, are suspended from the frame at the front and back pedestal jaws, while the Style B support, which is used to keep the straight edge from sagging, is placed midway between the Style A supports. It is essential that the heel *X* of both Style A and B supports rest against unmarred surfaces of the frame from which all grease has been removed. The straight edges are then placed on the supports in a manner such that they rest firmly against the shoulder *Y* of each Style A support.

With the straight edges in position on the frames, dimensions *A* and *B* shown in Fig. 2 are taken accurately. If these dimensions are equal, the frames are parallel and the machinist can proceed with the layout of the shoes and wedges. If the frames are not parallel, the straight edges must be made parallel to the horizontal center line between the frames shown in Fig. 2.

### Layout Example

Referring to Fig. 2, if dimension *A* were 57 in. and dimension *B* 57⅛ in., a 1/16-in. shim should be placed between the straight edge and its support at *A* in order to make the straight edges parallel.

The center of any jaw on the right side is then established as illustrated by the location of point *C* in Fig. 3. A parallel plate is then placed across the top of the frame, precaution being taken to keep the plate from rocking, and a try-square is placed on the parallel plate with the edge in line with the established center *C* of the jaw. A T-square is then placed across the straight edges and adjusted so that its blade touches the edge of the try-square located at the center of the jaw.

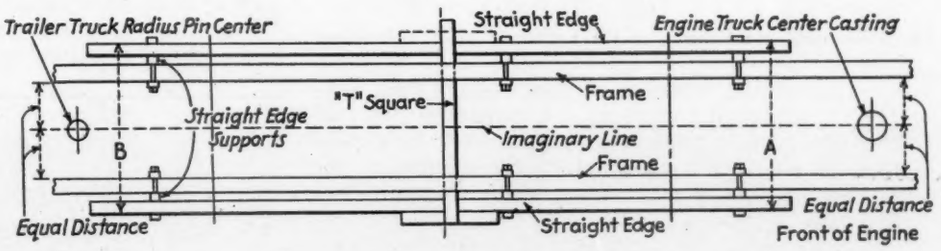



Fig. 2—Straight edges made parallel with a horizontal line between the frames

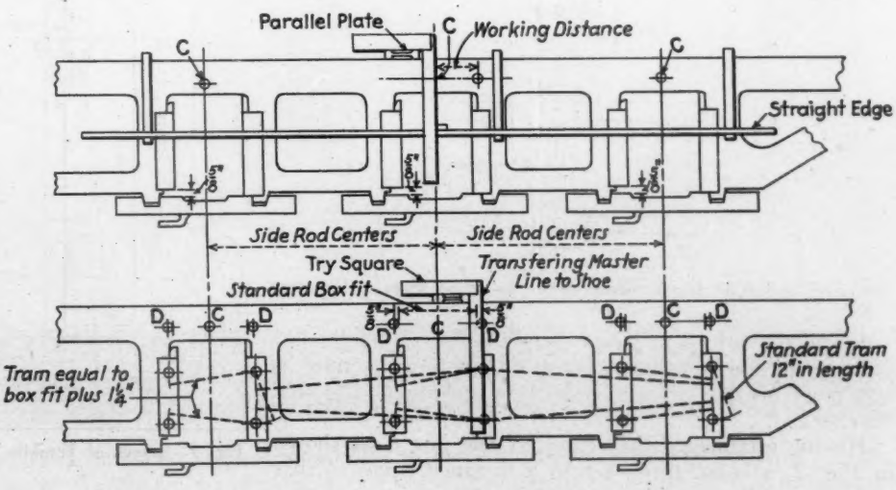



Fig. 3 (above)—Method of establishing center of pedestal jaws; Fig. 4 (below)—Method of laying out width of driving boxes on the frame

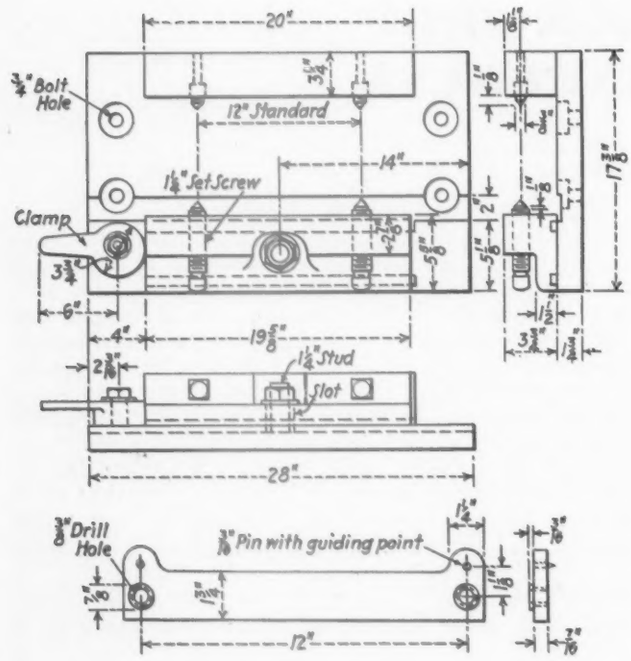



Fig. 5—Chuck that automatically lines up shoes and wedges for machining to layout marks

The try-square is then taken to the left side of the engine and placed on the parallel plate with the edge of the try-square against the edge of the T-square; while performing this operation the T-square must not be moved. A line is then scribed on the frame at the center of the jaws. The T-square is then taken to the left

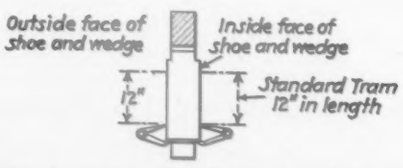



Fig. 6—Locating layout marks on the bottom of shoes and wedges

side of the engine, where it is placed against the edge of the try-square for checking the center of the jaw. If the jaw centers check correctly, centers have been established which are absolutely perpendicular to the center line of the engine, and the machinist can proceed

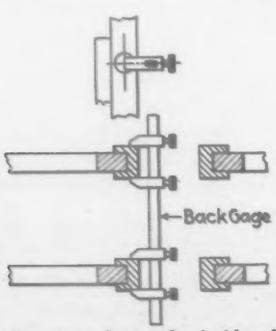



Fig. 7—Transferring layout marks to the inside of shoes and wedges

with the layout of the shoes and wedges. If the jaw centers do not check correctly, either the T-square is not true, or the straight edges are sprung and should be checked.

Having established the center of one jaw *C* as shown in Fig. 2, a beam tram, set to a distance equal to that

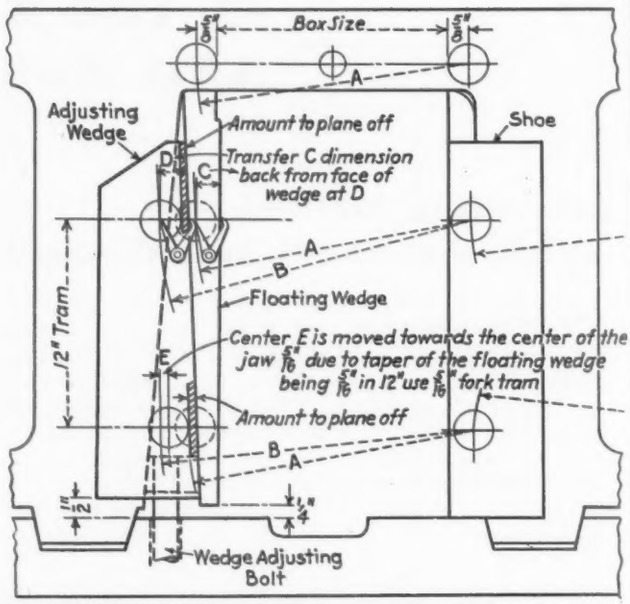



Fig. 8—Method of laying out Franklin automatic adjustable driving box wedge with taper floating-plate

between the wheel centers, is placed in this center and other points, also designated at *C* in Fig. 3, are scribed on the remaining jaws, thus establishing the correct center of each jaw.

After these centers have been located, the shoes and wedges are mounted on the pedestal jaws, using suspenders to hold them firmly against the jaw faces. From the points *C*, half the width of the driving box, plus the dimension of the proof ring tram (in this case 5/8 in.) is laid off on both sides of the center *C*, thus establishing the points *D* shown in Fig. 4. With the try-square supported on the parallel plate in a position such that the edge of the try-square in line with the points *D*, a line is scribed the full length of each shoe and wedge. The chuck shown in Fig. 5, is then used for planing the shoes and wedges to the layout marks. Where this chuck is used a four-point layout is necessary. Since it is not practical to establish the layout

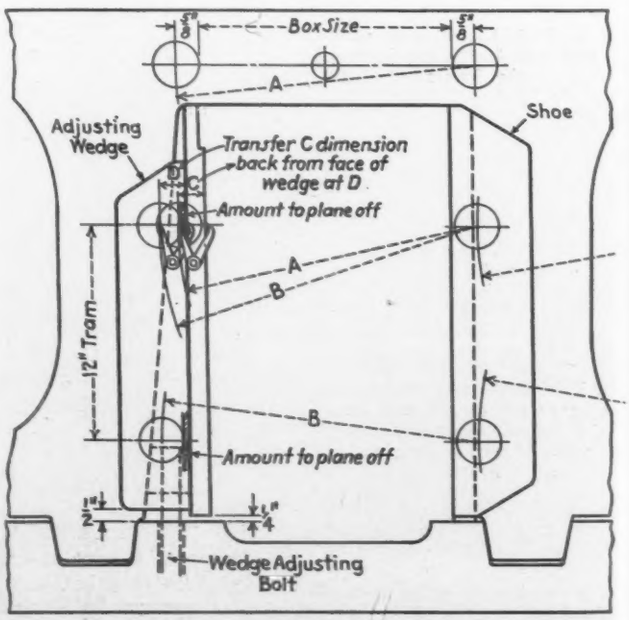



Fig. 9—Layout of Franklin adjustable wedge of the straight floating-plate type

marks absolutely perpendicular across the shoes and wedges a lateral movement of ½ in. is provided in one of the chuck jaws.

The bottom layout marks should be established with a pair of hermaphrodites from the bottom of the shoe and wedge; the upper marks are correctly established with a fixed 12-in. tram. This method is shown in Fig. 6. The shoes and wedges are laid out on the face as described previously, and then the layout marks are transferred to the inside face by means of the back marker shown in Fig. 7.

Figs. 8 and 9 illustrate the methods followed in laying out Franklin automatic adjustable driving-box wedges of the tapered floating-plate type and straight floating-plate type, respectively.

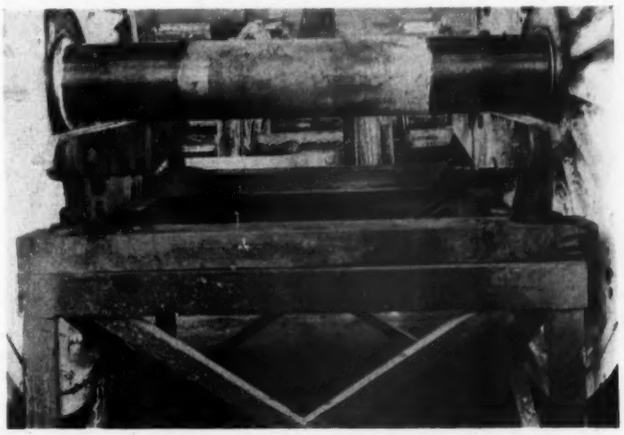
## Denver Shop Jigs And Devices

Among numerous special jigs and devices of unusual interest at the Denver, Colo., shops of the Chicago, Burlington & Quincy is a roller-bearing counterbalance stand shown in the illustration. This stand consists of a rigidly braced, welded, steel framework, 50 in. wide by 54 in. long by 36 in. high, constructed primarily of 4-in. by 4-in. by 3-in. and 2-in. by 2-in. angle section joined by electric welding.

The weight of the driving wheel and axle assembly is supported by the journals bearing on two pairs of steel rolls, each pair of rolls operating in the same plane and being suitably mounted in a built-up beam construction which can be readily leveled or adjusted for height by means of four 1-½-in. adjusting units, one at each corner of the counterbalance stand. The supporting rolls for each journal are 5-in. in diameter and set between a pair of 1-in. steel-plate beams 50 in. long by 6 in. wide at the center, tapered to 3½ in. wide at each end.

As compared to the usual parallel straight-edge type of counterbalance stand, this design possesses the important advantage of greater sensitiveness, greater ease of adjustment and increased safety. With accurate, well lubricated rolls and clean journals, the heavy driving wheels will revolve easily and be responsive almost to the finger-touch. By means of the adjusting screws and nuts, the supporting bars may be readily adjusted for equal height and level, and, moreover, it is not necessary to use the same painstaking care in levelling as would be required with a counterbalance stand of the parallel-straight-edge type.

The fact that the driving wheels and axle revolve in one fixed position instead of rolling along a pair of straight edges, may be conceded as a somewhat safer

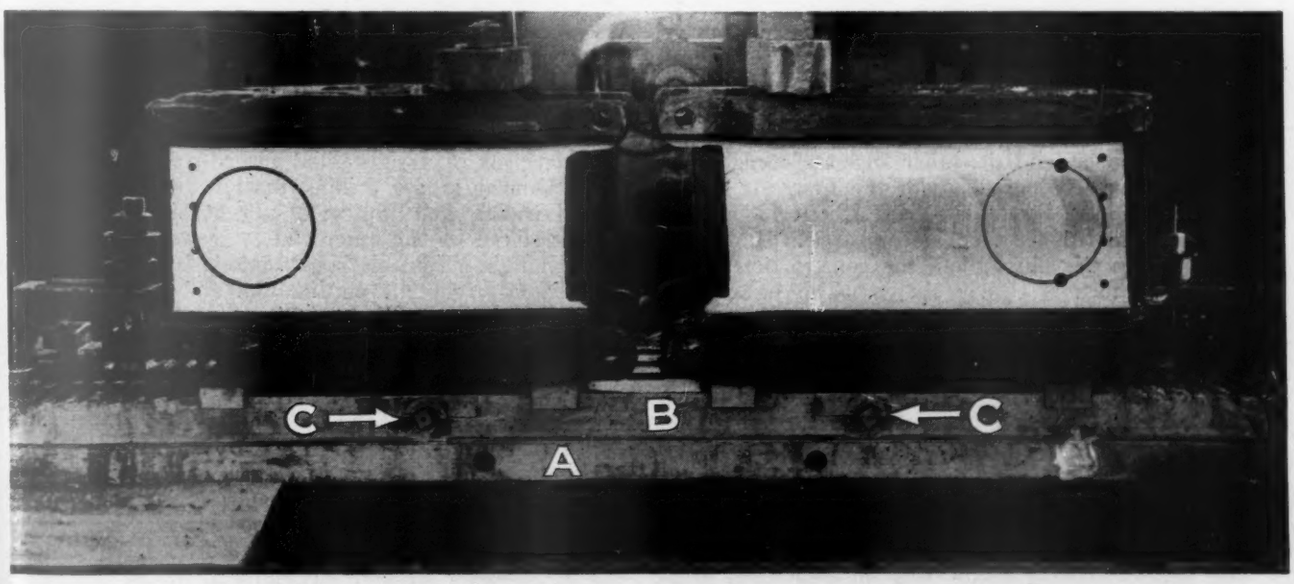


Roller-bearing counterbalance stand used at the Denver shops of the C. B. & Q.

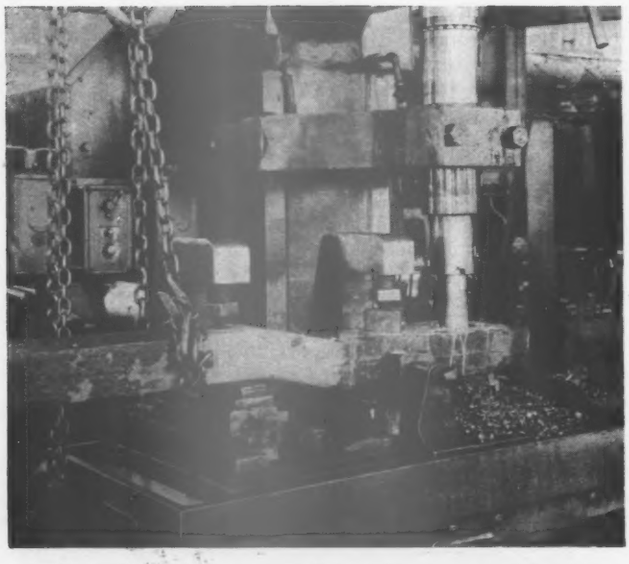
operation, since there is no possibility of the wheels rolling off the end of the stand. A still further advantage of this type of counterbalance stand, due to the fact that each pair of supporting rolls operates in the same plane, is that the bearing rolls occupy only a short length on each journal and may be readily used in the limited space sometimes available when driving journals are designed for the application of roller-bearing boxes.

### Milling Driving-Box Shoe-and-Wedge Ways

The large Morton cylinder-boring machine, not being kept busy exclusively on cylinder work, is used to advantage in milling the shoe-and-wedge faces of driving boxes by means of a special chuck shown in one of the




Special jig used in milling driving-box shoe-and-wedge faces on a Morton cylinder-boring machine

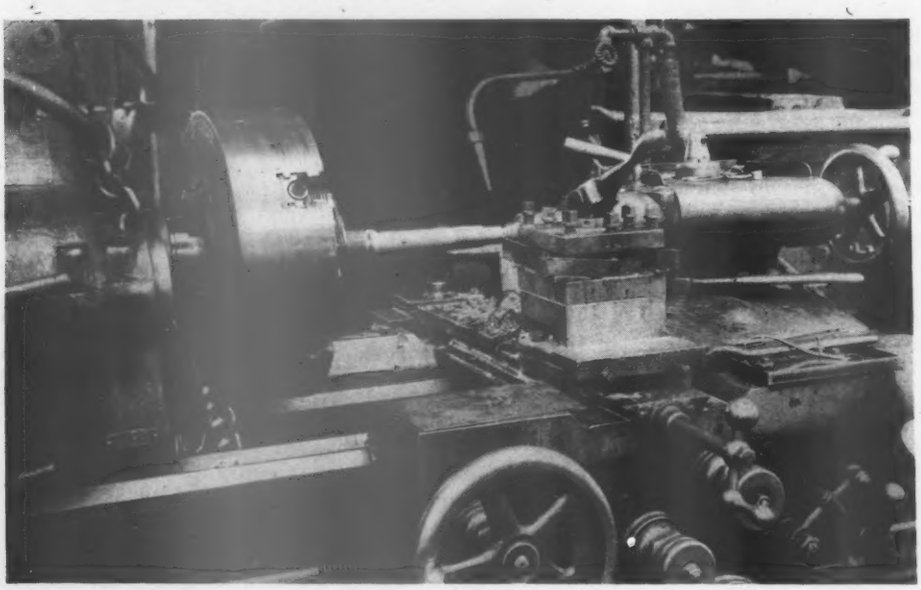


Rigid clamping device and outboard spindle support used in boring drawbar holes on a heavy-duty drill

equipped with two centering chucks operated by the screws (CC). With this equipment, the driving boxes are quickly and accurately lined up and centered on the jig. The clamping arrangement consists of four 1-in. hold-down bolts and nuts, these bolts extending through suitable U-bars one at each end and one across the upper face of each driving box. This method of clamping proves entirely adequate to hold the boxes during the relatively light milling operation which is done with a face milling cutter in the boring-machine spindle.

### Drill Set-Ups for Boring Drawbar Holes

The use of a Baker 5-in., heavy-duty drilling machine for refinishing one of the holes in a locomotive drawbar is shown in one of the illustrations. The drawbar, in this instance of the offset type, is securely clamped to the drilling-machine table by means of a pair of exceptionally heavy forged-steel clamps having a 2-in. adjusting nut in the top of each, with taper point which is used to bring pressure either directly against the drawbar or against a pressure block which rests on it. The drawbar is held against side slip by a separate clamp equipped with a pressure-adjusting screw in the



Boye & Emmes 18-in. portable engine lathe equipped for machining and fitting locomotive frame bolts in the erecting shop

illustrations. This chuck is of the self-centering, swivel type so that set-up time is minimized, and, when one side of a pair of boxes has been machined using a face mill in the boring-machine spindle, the chuck can be readily swiveled through 180 deg., index pins inserted to hold it in place, and the other shoe-and-wedge faces machined accurately parallel with the first. It is said that this method of machining gives a better job in approximately one-half the time, as compared with planing.

Referring to the illustration, the construction of the driving-box chuck is clearly shown. The jig consists essentially of two steel plates 60 in. long by 15½ in. wide by 2 in. thick, base plate *A* being provided with a tongue on the longitudinal center line which fits a groove in the Morton boring-machine table. Plate *B* is arranged to swivel on plate *A* about a 1-in. center bolt (not visible in the illustration) which passes through plate *A* to the boring machine table. Two index bolts, provided at opposite corners of the jig, accurately locate plate *B* with respect to plate *A* in either one of two 180-deg. positions.

The pair of driving boxes rest on four steel cross bearing pieces set into the face of the jig which is upper end and a T-shape projecting rib on the bottom to fit the T-slot of the drilling machine table.

To provide ample rigidity and, at the same time, free rotation of the drilling machine spindle, a heavy outboard support is provided, as shown in the illustration. This consists of a substantial forged-steel bracket suitably clamped to the drilling machine column and designed with a well lubricated split bushing and removable steel cap on the outer end to serve as a guide for the spindle. With this construction, fairly heavy cuts may be taken by the cutting tool and irregular holes trued up quickly and accurately on a drilling machine, at less cost than if done on a boring machine.

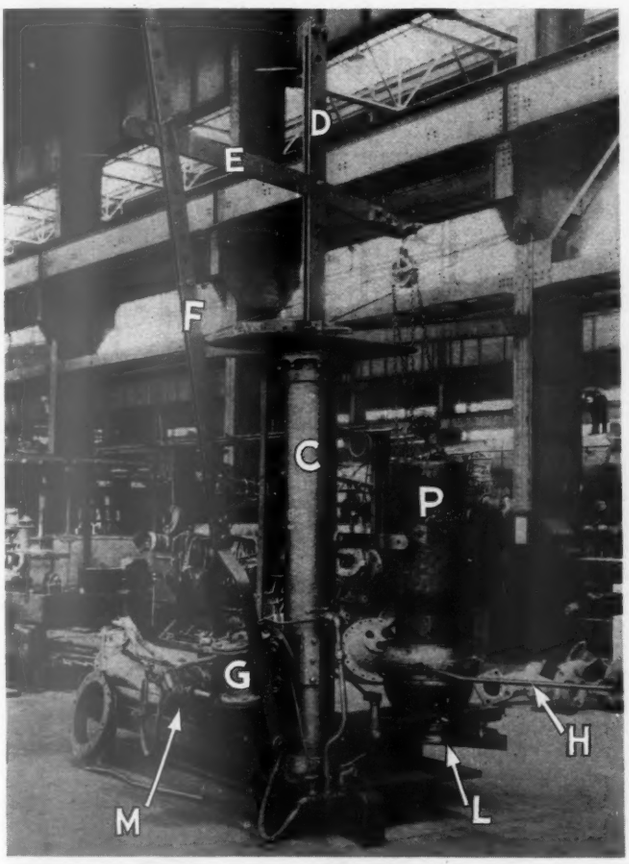
### Making and Fitting Locomotive Frame Bolts

Locomotive frame bolts are manufactured on a Boye & Emmes 18-in. portable engine lathe, located in the erecting shop adjacent to the locomotive for which bolts are being fitted. The material used in making these bolts is a special heat-treated steel and the bolts are made directly from round bar stock, with only a 3/16-in. shoulder allowed for the head of the bolt. All of the operations, including taper turning, threading

and cutting off are done on this lathe with a minimum of lost motion, unnecessary steps, etc.

Referring to the illustration, it will be observed that the engine-lathe carriage has been provided with a turret head equipped with all of the tools necessary for turning, thread cutting and cutting off. The bar stock is gripped in a four-jaw universal chuck and a special ball-bearing dead center is used to reduce friction and serve as a firm support for the outer end of the bolt. The lathe is equipped with a taper attachment for cutting the bolt taper, and a fluid pump, with suitable pipe connections, gives an adequate flow of coolant so that fast cutting feeds and speeds may be used.

The success of this method of individual bolt fitting hinges very largely on the skill of the machine operator who, after suitable experience, can turn out completely




**Unusually convenient machine, operated by one man, for grinding the joints in long dry pipes and exhaust pipes**

finished bolts all threaded and ready for application in from 3 to 5 minutes apiece, dependent upon the bolt size. One of the primary advantages of this method is the saving in time formerly required going to and from the machine shop or storehouse to secure engine bolt supplies. Moreover, it avoids the necessity of carrying a large stock of bolts on hand and there is a considerable saving in material as bolts are made with just the right length in the first place, and it is not necessary to cut them off and rethread the ends, as frequently happens when engine bolts are drawn from stock and the exact length needed may not be available.

Still another advantage is that the bolt holes in locomotive frames, guide blocks, cross ties, cylinder saddles, etc., need not be reamed out to some standard size, but are reamed only enough to provide a smooth, true hole to which the bolt is fitted. This avoids the rapid and undue enlargement of bolt holes, with attendant weakening and reduced service life of the associated parts, some of which have definite limits as regards bolt-hole size.

### One Man Operates Dry-Pipe Grinding Machine

The dry-pipe grinding machine, shown in the illustration, is interesting not only because it was designed and built at the Denver, Colo., shops of the C.B.&Q., but because it represents an unusually compact and efficient design which can be readily operated by one man.

The machine is built on a heavy cast-iron base plate 6 ft. long by 40 in. wide, monuted on short legs and supporting, at the nearest corner, a standpipe column *C* 9 in. in diameter by 66 in. high, equipped with a 42-in. by 19-in. by ¾-in. steel footplate on top on which a man can stand while adjusting the various lever arms and fulcrum pin position required, dependent upon the length of the dry-pipe being ground. The double-bar vertical arm *D*, made of two pieces of 4-in. by ¾-in. steel, 5 ft. 2 in. long, extends directly above the standpipe column and serves as a fulcrum for a 5-ft. cross lever *E*, connected at the short end by means of chain falls to the dry-pipe and at the other end to long double-bar arm *F*. The lower end of arm *F* is equipped with a yoke for connection to air cylinder *G* which is firmly bolted to a bracket on the standpipe column. Admission of air to the cylinder by means of a small air valve forces the piston down and raises the dry-pipe three or four inches whenever it is necessary to apply new oil or abrasive to the joint which is being ground, or to make a visual inspection of the progress of the work.

The base of the machine is equipped with the operating table *L* of a link grinder. This table is given a partial rotary and reverse motion by means of suitable lever connections and gear-reduction drive from an air motor *M*. The dry-pipe itself is held against turning by means of handle *H* on a special clamp, and the nigger head, ball joint, or whatever casting forms the lower part of the joint, is bolted to T-slots in table *L* and given a partial rotary and reverse motion whenever the machine is in operation.

The table speed may be varied to suit the size of the joint being ground, but is usually adjusted to about 40 reversals per minute.

In the illustration, the exhaust pipe *P* of an articulated locomotive is being ground to a seat on one of the large ball joints required to make a flexible connection. This heavy pipe may be readily raised whenever necessary for redistributing the oil and abrasive, or for inspection, by simply opening a small valve which admits air to the cylinder. This is a three-way valve which, when closed, exhausts air from the cylinder and lowers the pipe *E* back on the ball seat. The feature of this machine is that mechanical labor in grinding dry-pipe joints is eliminated and one man can do the job, whereas two or more were formerly required.

## Addition to Murex Coated Electrodes

The Metal & Thermit Corporation, New York, announces an addition to its line of Murex heavy coated electrodes for arc welding. The electrode, known as Murex type N, is designed for bridging gaps where the fit between plates is poor and, in the smaller sizes, may

be used on vertical and overhead work, or to make rapid, single pass welds on light gage materials. In addition, it can be used to produce single or multiple pass fillets.

The physical properties of the metal deposited by the Murex type N electrode are said to range from 74,000 to 84,000 lb. per. sq. in. in tensile strength with 26 to 24 per cent ductility. The electrode is also said to work equally well with either direct or alternating current and may be used either with straight or reversed polarity.

## Electric-Hydraulic Riveter

An electric-hydraulic riveter has recently been added to its line by the Hanna Engineering Works, Chicago, Ill. The power unit of the riveter is a combination of a motor-driven primary pump, a valve mechanism and an intensifier. The fluid pressure developed is transmitted to the riveter by flexibile high-pressure hose. It provides a rapid advance of the ram to the rivet, and the rapid return of the ram to its normal position.

The operator controls the riveting cycle by depressing a pilot or trigger switch which operates a solenoid-actuated valve permitting the fluid under primary pressure to flow directly to the riveter cylinder. At the instant the riveter ram or plunger has preformed the rivet to whatever is within the capacity of the primary pressure, the intensifier acts automatically to boost the pressure to that which will finish the rivet. When the maximum pressure has been exerted upon the rivet, the primary control valve is automatically reversed, and the ram returns to the starting position whereupon the primary control valve automatically shifts to its neutral position.

Portable 20-ton electric-hydraulic riveter

The release of the pilot switch will reverse the ram movement whether it be in the primary or high-pressure stage of the riveting cycle. Likewise, depressing the pilot switch will change the return ram movement to a forward or driving stroke. As long as the operator depresses the pilot switch the riveter will complete a cycle and only one. He must release the switch and depress it again to start another cycle. Thus, a repeat cycle cannot take place.

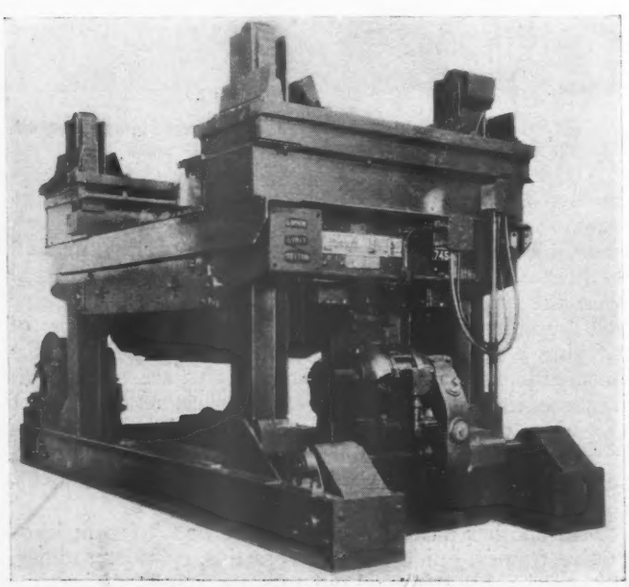
To protect the operator, a low-voltage transformer is built into the power unit for the pilot-switch circuit. Thermal-overload relays protect the motor. The unit illustrated exerts 20 tons on the dies and is capable of driving ⅜-in. rivets cold, forming a full button head. Portable and stationary units for driving rivets up to 1⅛ in. hot are also available.

## All-welded Drop Pit Table

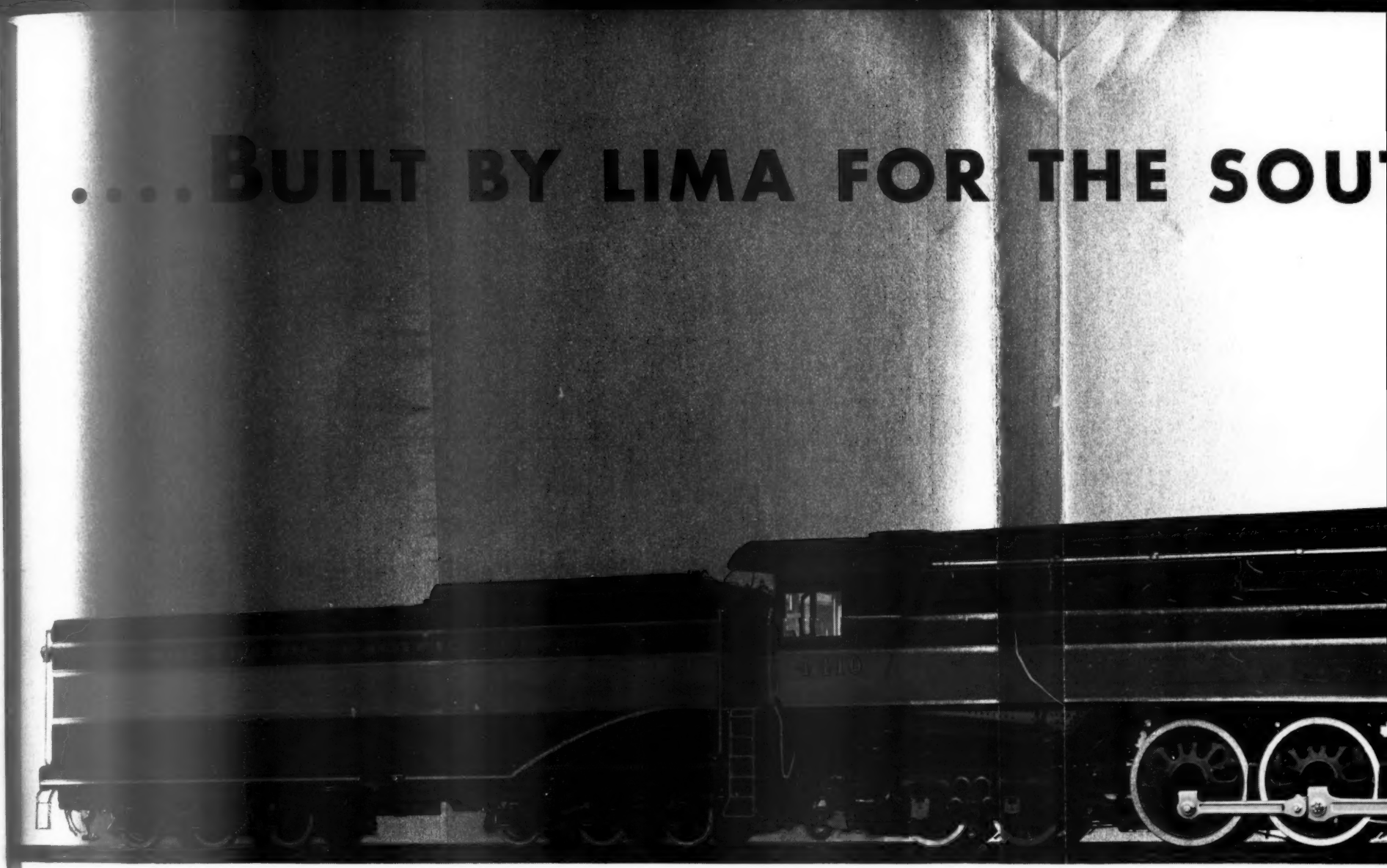
The Shaw Box Crane & Hoist Company, Inc., Division of Manning, Maxwell & Moore, Inc., Muskegon, Mich., has developed a drop-pit table of all-welded construction for use at division-point back shops and roundhouses. This unit is constructed entirely by arc welding and is made in both movable and stationary types for removing and replacing locomotive driving-wheel sets and engine and trailer trucks, as well as for use in car shops.

Three independent units make up the complete table—the truck, lifting table and table top. The lifting table, operated by push-button control, is raised and lowered between rigid steel columns, mounted on the truck, by four drums and four flat steel flexible cables. The drums are operated simultaneously by one motor through two duplicate gear drives contained in the table. Hence, an equal pull is applied at each corner of the table. The columns support and guide the table. The table top is detachable and is equipped with locking bars and sections of rails to form a continuous track over the pit when locked in position.

The feature of the design of this drop-pit table is the use of the four flexible cables and winding drums for raising the load, rather than the former practice of using jack screws. This permits the raising or lowering of the load without spotting accurately on the table top. The

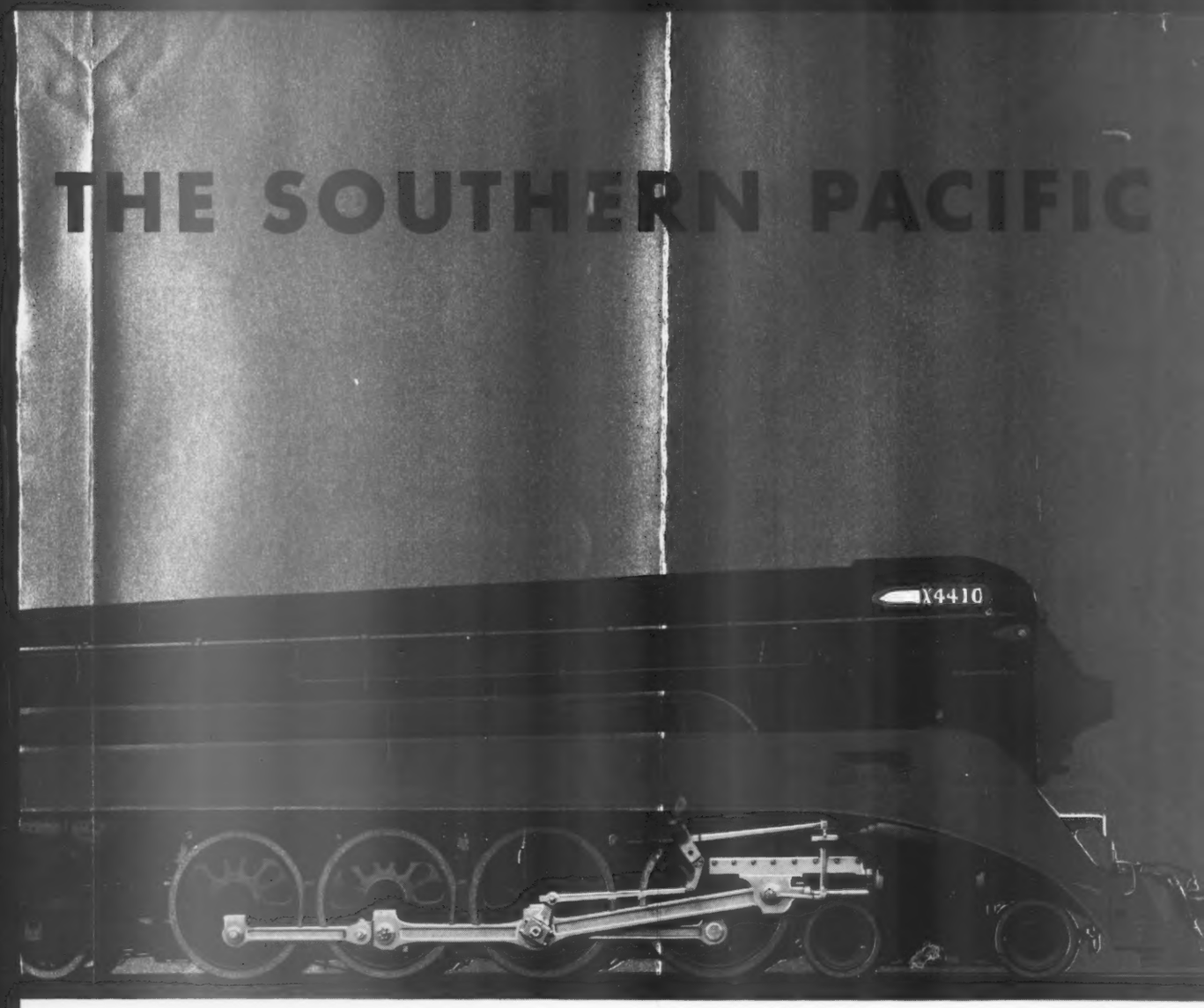


The Shaw arc-welded drop-pit table




SIX of the above locomotives were delivered during December by Lima Locomotive Works, Incorporated, to the Southern Pacific Railway Company. • This power will be used for the new *Daylight* Specials between San Francisco and Los Angeles. The trains are now building and the
monize in color a
fourteen additio
has been placed
locomotives, ho
will have 80-inch

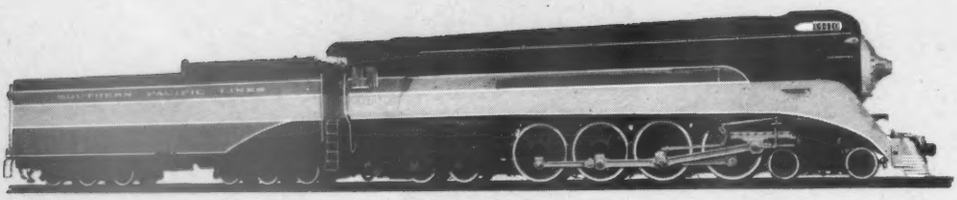
LIMA
LOCOMOTIVE WORKS
INCORPORATED




building and the cars and locomotives harmonize in color and streamlining. An order for fourteen additional locomotives of this type has been placed with Lima. • These additional locomotives, however, will be larger. They will have 80-inch drivers and weigh 455 tons.

, INCORPORATED, LIMA, OHIO

# THE LARGEST STREAMLINED LOCOMOTIVES *in The World*



# SOUTHERN PACIFIC 4-8-4

| WEIGHT IN WORKING ORDER, POUNDS | | | | |
|---|---|---|---|---|
| On Drivers | Engine Truck | Trailer Truck | Total Engine | Tender Loaded |
| 266,500 | 77,400 | Front 46,300<br>Rear 58,200 | 448,400 | 372,880 |

| WHEELBASE | | | | TRACTIVE EFFORT | |
|---|---|---|---|---|---|
| Driving | Engine | Eng. & Tender | Length Over All | Main Cylinders | With Booster |
| 20' 0" | 45' 10" | 94' ½" | 109' 6" | 62,200 | 74,710 |

| BOILER | | CYLINDERS | | DRIVING WHEEL |
|---|---|---|---|---|
| Diameter | Pressure | Diameter | Stroke | Diameter |
| Front 86" O. D.<br>Rear 96" O. D. | 250 lb. | 27" | 30" | 73½" |

LIMA
LOCOMOTIVE WORKS
INCORPORATED

## LIMA LOCOMOTIVE WORKS, INCORPORATED

LIMA, OHIO

The Shaw arc-welded drop-pit table installed at the Cincinnati Union Terminal, Cincinnati, Ohio

table is moved along its track on four wheels driven by gearing connected with an electric motor mounted on the base of the unit.

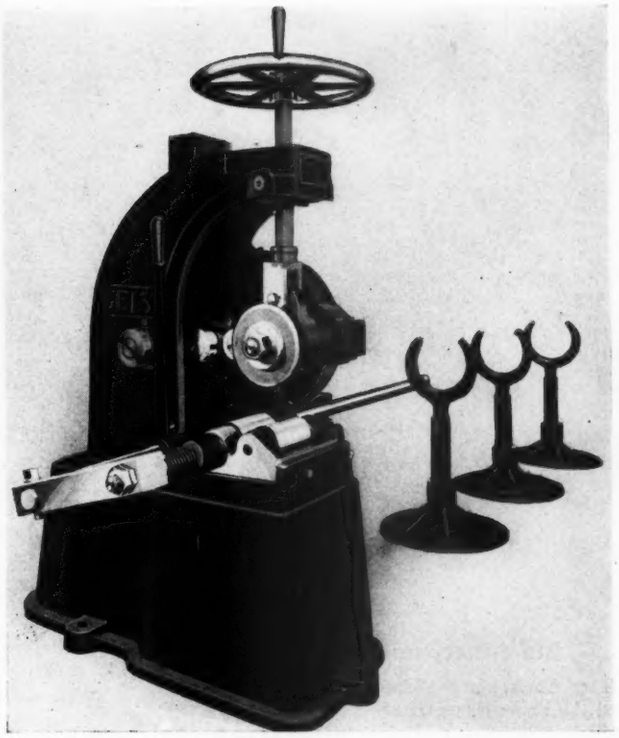
The unit is supported by four standard H-columns carried on and welded to a base composed of two H-columns welded integral with cross connecting members. Additional stiffness is provided the vertical columns by steel gusset plates welded to them and to the base. The lifting table is also fabricated by welding a number of separate parts, including channels, H-columns, plate, and angles, into a single piece of steel. Arc welding is reported to save approximately 15 per cent in weight.

Operating advantages claimed for the arc-welded drop-pit table are as follows: It will not bind or stick when loading is unbalanced because it is designed for unbalanced loading and there is an equal pull at each corner of the table. The water nuisance sometimes prevalent in pits is eliminated because there are no guides to destroy water proofing in pit walls. Maintenance costs are low because all gearing operates in baths of oil in sealed enclosures. It is safe because it cannot be lowered except by power, and the table stops instantly when power is shut off. The table is stopped by an automatic stop when it reaches its highest or lowest position.

## Improved Geist Roller Pipe Cutter

An improvement has been made recently on the No. 4 Geist roller pipe cutter which is marketed by the Landis Machine Company, Waynesboro, Pa. The shaft which carries the disc cutter is now being mounted in Timken roller bearings instead of bronze bushed bearings as heretofore used.

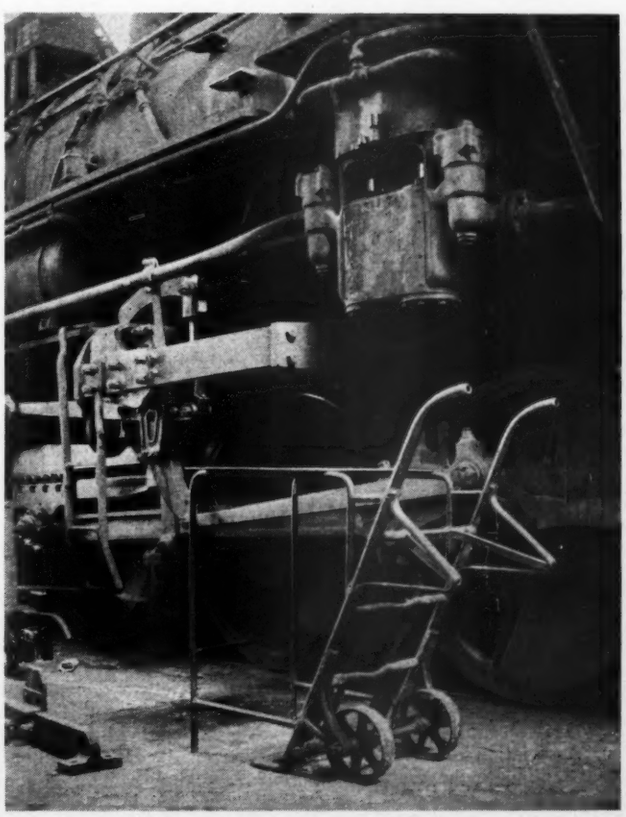
This improvement has been incorporated in the cutter to give it added rigidity and to insure precise alignment



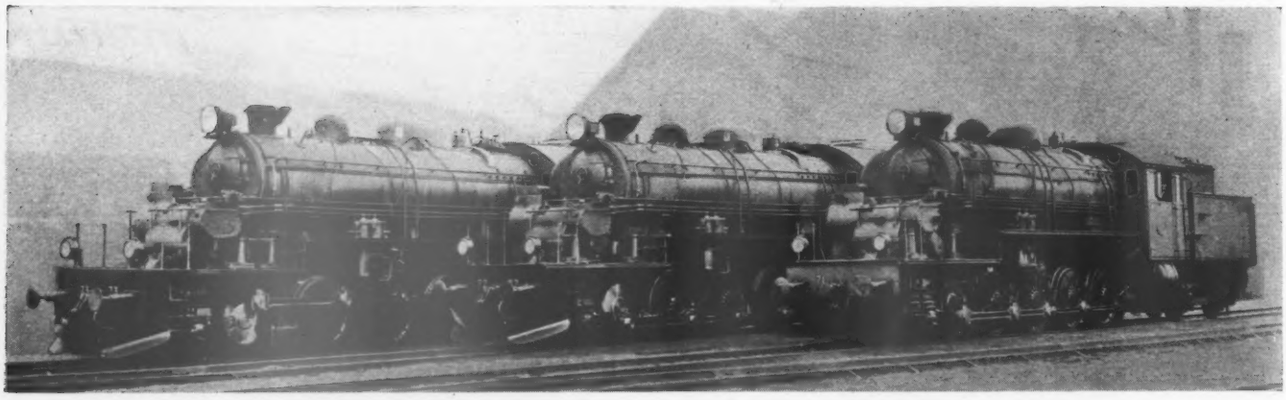
The Geist pipe cutter with the disc mounted in Timken roller bearings

between the cutter shaft and the rollers, thus minimizing the cutting time, reducing the burr thrown up on the pipe and increasing the life of the disc cutter. The machine can be used for cutting ½-in. to 4-in. pipes, inclusive.

* * *



Convenient, safe and portable steel platform



Non-condensing steam turbine locomotives on the Grangesberg-Oxelosund Railways in Sweden

# NEWS

## Machinery and Tools

THE *Louisville & Nashville* has authorized the expenditure of about $500,000 for new shop machinery during 1937.

*The New York, New Haven & Hartford* has ordered a 90-in. driving wheel lathe from William Sellers & Co., Inc.

*The Western Pacific* has ordered one 200-ton wrecking crane and several special shop tools from the Industrial Brownhoist Company.

## The Swedish Turbine Locomotives

THE photograph reproduced on this page shows three Ljungstrom non-condensing steam turbine locomotives on the Grangesberg-Oxelosund Railways in Sweden. The locomotive in the foreground has been in service since 1932 and the two back of it have been placed in service more recently. The older locomotive has made about 135,000 miles in slow-speed heavy freight service, running about 71,500 miles between general repairs, which is said to compare with 31,000 to 36,000 miles for the reciprocating locomotives on this railroad. Comparative tests between older turbine and reciprocating locomotives which were run in July, 1933, are said to have shown a fuel saving of 23.8 per cent for the turbine locomotive, and the low fuel consumption of the turbine locomotive is said to be still maintained. The locomotive has an adhesive weight of 72 tons and is in service hauling iron-ore trains of 750 tons on 1 per cent ruling grades.

## More Attention to Maintenance of Draft Gears

IN Circular DV-889 recently issued Secretary Hawthorne of the Mechanical Division, Association of American Railroads, calls attention to the fact that on June 9, 1936, W. J. Patterson, director, Bureau of Safety, Interstate Commerce Commission, advised that from the investigations of accidents attributable to draft-gear failures it is evident that the recommended practice rules covering inspection and maintenance of draft gears and attachments by car owners adopted by letter ballot in 1934 are not being complied with by some carriers and private-car lines. The circular urges the member roads and private-car owners to establish a program of draft-gear maintenance conforming to the A.A.R. recommended practice and requests that each railroad and car owner submit to the secretary of the Mechanical Division a copy of such instructions as may now be issued to carry out the recommended practice of the association.

## Observance of Loading Rules

MECHANICAL Division Circular D. V.—890, recently issued by the secretary, reads as follows:

Complaints are being received that some railroads are accepting open top cars on which loads are not secured in accordance with the Rules Governing the Loading of Commodities on Open Top Cars. Some of these complaints have been investigated by the Mechanical Inspection Department and found to be justified.

Interchange Rule 2 provides that loaded cars must be accepted with certain exceptions, one of which is—

"(c) Cars improperly loaded (not conforming with the Rules Governing the Loading of Commodities on Open Top Cars) when transfer or rearrangement of lading is necessary, even though the load may have originally conformed to such rules."

This rule provides for the rejection of improperly loaded cars at interchange but, since it and the loading rules to which it refers, were promulgated in the interest of safety and contain the minimum requirements for the safe transportation of commodities involved, it is important that full and complete observance be insisted upon whether it be in connection with loads offered in interchange or those offered for exclusive movement over the rails of an individual carrier.

It is urged that proper instructions be issued to all concerned that no loads will be accepted or offered for movement which do not comply with the Rules Governing the Loading of Commodities on Open Top Cars.

## Equipment Building and Betterment Programs

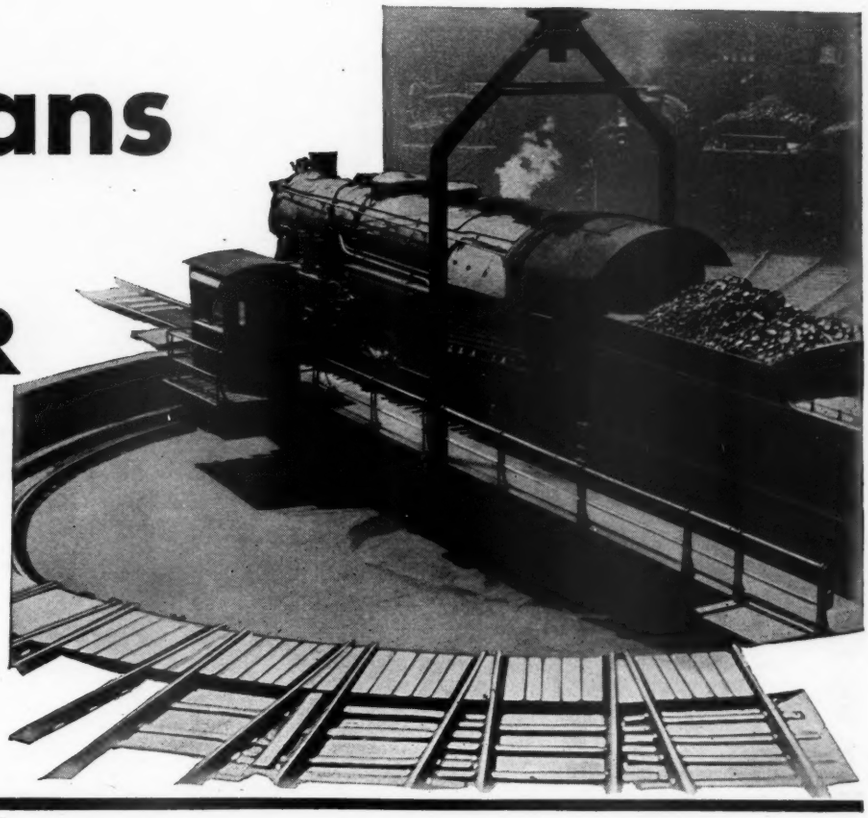
THE *Southern Pacific* has announced plans for the construction and rebuilding of passenger, freight and motive power equipment to cost more than $16,500,000, bringing the company's total appropriation for new and modernized cars and locomotives during the last 12 months to over $41,000,000. The latest appropriation provides for the expenditure of nearly $15,000,000 for new rolling stock and motive power and includes the following items: 28 new steam locomotives—14 to be streamlined and designed for passenger service; 2,725 new freight cars, including 1,175 automobile cars; 41 new passenger cars—all of modern light-weight type. Air-conditioning and modernization of passenger-train equipment will cost $1,200,000. Details of orders for some of this equipment are reported elsewhere in these columns.

*The St. Louis Southwestern* has been authorized by the federal court to spend $1,825,715 for the building of 5 locomotives, the purchase of 10 air-conditioned passenger coaches and for general additions and betterments.

*The Great Northern* has adopted a program of rehabilitation calling for the expenditure of $33,000,000, the completion of the program depending upon a continued rise in the company's revenues. Of the total, $22,000,000 will be spent for regular maintenance work; $6,500,000 for 500 new ore cars, 500 gondola cars and 1,000 box cars (reported elsewhere in these columns); $2,750,000 for rebuilding 11,000 freight cars in company shops, and the purchase of 12 coaches; and $1,750,000 for rails and fastenings.

(*Continued on second left-hand page*)

# Jim Evans and BOOSTER POWER!



You have read about Jim Evans in the Railway Mechanical Engineer and sympathized with his problems. A few days ago he found the Booster a "life saver."

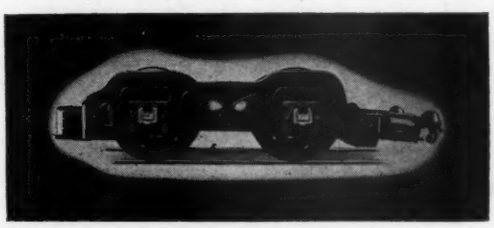
He was right up against it for an engine for a heavy fast freight. The regular engine was delayed by a firebox patch—the shop air compressor broke down and the job just couldn't be finished in time.

He had to send out a lighter engine to haul the train. But it had a Booster.

The added power of the Booster enabled the locomotive to start the train and get it over the ruling grade.

Schedules were maintained and there were no "explanations" to worry about.

On any locomotive the Booster places it in the class above in the hauling capacity.



Because material and tolerances are just right for the job, genuine Franklin repair parts give maximum service life.

**FRANKLIN RAILWAY SUPPLY COMPANY, INC.**

NEW YORK CHICAGO MONTREAL

# New Equipment—Orders and Inquiries Announced Since the Closing of the December Issue

## Locomotive Orders

| Road | No. of locos. | Type of loco. | Builder |
|---|---|---|---|
| A. T. & S. F. | 11 [1] | 4-8-4 Pass. | Baldwin Locomotive Works |
| | 6 [1] | 4-6-6-4 Pass. | |
| | 10 | 2-10-4 Frt. | |
| B. & L. E. | 10 | 2-10-4 | American Locomotive Co. |
| | 2 | 0-8-0 | |
| C. B. & Q. | 10 [2] | 4-8-4 | Company shops |
| D. & R. G. W. | 10 | 4-6-6-4 | Baldwin Locomotive Works |
| | 5 | 4-8-4 | |
| D. L. & W. | 5 [3] | 4-6-4 | American Locomotive Co. |
| S. A. L. | 5 | 2-6-6-4 | Baldwin Locomotive Works |
| Sou. Pac. | 10 | Tenders | |
| | 14 | 4-8-8-2 Frt. | Lima Locomotive Works |
| | 14 | 4-8-4 streamline | |
| Union R. R. | 4 | 0-10-2 | Baldwin Locomotive Works |
| Western Pac. | 7 | 4-6-6-4 | American Locomotive Co. |
| | 4 | 2-8-8-2 | Baldwin Locomotive Works |
| W. & L. E. | 10 [4] | 2-8-4 | American Locomotive Co. |
| Weyerhaeuser Timber Co. | 2 | 2-6-6-2 | Baldwin Locomotive Works |

## Freight-Car Orders

| Road | No. of cars | Type of car | Builder |
|---|---|---|---|
| A. T. & S. F. | 1,500 | 50-ton box | Pullman-Standard Car Mfg. Co. |
| | 500 | 50-ton box | American Car & Fdry. Co. |
| | 200 | 50-ton refrig. | General American Trans. Corp. |
| | 500 | 40-ton refrig. | |
| | 325 | 70-ton gondola | |
| C. & N. W. | 500 | 70-ton auto | Pressed Steel Car Co. |
| | 500 | 50-ton auto | Mt. Vernon Car Mfg. Co. |
| C. & O. | 500 | Gondolas | American Car & Fdry. Co. |
| | 500 | Hopper | |
| | 500 | Box | General American Trans. Corp. |
| | 500 | Hopper | Pullman-Standard Car Mfg. Co. |
| | 50 | Caboose | Magor Car Corp. |
| | 25 | 70-ton dry bulk | American Car & Fdry. Co. |
| | 50 | 40-ton stock | Greenville Steel Car Co. |
| C. B. & Q. | 1,000 [2] | 50-ton steel frame box | Company shops |
| | 250 [2] | Steel frame auto. | |
| | 250 [2] | All-steel hopper | |
| | 1,500 [2] | Gondolas | |
| | 100 [2] | Flat | |
| | 150 [2] | Steel frame stock | |
| | 300 [2] | Refrig. | Refrigerator Express Co. [2] |
| D. & H. | 60 | 55-ton hopper | Company shops |
| | 100 | 40-ton box | |
| D. & R. G. W. | 100 [5] | 70-ton Hart selective ballast | American Car & Fdry. Co. |
| Dominion Steel & Coal Corp., Ltd. | 100 | Hopper | Eastern Car Co. |
| D. M. & N. | 50 | Hopper | Ryan Car Co. |
| E. J. & E. | 200 | 50-ton hopper | Mt. Vernon Car Mfg. Co. |
| | 750 | 50-ton gondolas | |
| | 100 | 65 ft., 70-ton gondolas | |
| Gen. Chemical Co. | 97 | 50-ton tank | General American Trans. Corp. |
| | 28 | 70-ton tank | |
| | 15 | 40-ton tank | |
| Godfrey L. Cabot, Inc. | 10 | 35-ton special hoppers | Pressed Steel Car Co. |
| Grt. Nor. | 500 | Ore | Bethlehem Steel Co. |
| Montour R. R. | 500 | Hopper | Pullman-Standard Car Mfg. Co. |
| N. & W. | 1,000 | 55-ton hopper coal | Bethlehem Steel Co. |
| N. Y. C. & St. L. | 500 | 50-ton gondolas | American Car & Fdry. Co. |
| | 25 | 70-ton dry bulk | |
| | 500 | 50-ton box | General American Trans. Corp. |
| | 100 | 50-ton auto-box | Ralston Steel Car Co. |
| | 75 | 50-ton hopper | Pullman-Standard Car Mfg. Co. |
| N. Y., N. H. & H. | 150 | Low-side coal | Company shops |
| | 75 | Flat | |
| Pacific Fruit Express | 500 [6] | Refrig. | General American Trans. Corp |
| | 500 [6] | Refrig. | American Car & Fdry. Co. |
| | 500 [6] | Refrig. | Pullman-Standard Car Mfg. Co. |
| | 500 [6] | Refrig. | Pacific Car & Fdry. Co. |
| Pere Marquette | 25 | Caboose | Magor Car Corp. |
| Reading | 25 | All-steel Caboose | Company shops |
| Seaboard Air Line | 1,000 | Box | Pullman-Standard Car Mfg. Co. |
| Sou. Pac. | 250 | Box | American Car & Fdry. Co. |
| | 250 | Box | Pullman-Standard Car Mfg. Co. |

## Freight-Car Orders—Continued

| Road | No. of cars | Type of car | Builder |
|---|---|---|---|
| Southern Pacific (Continued) | 250 | Box | Pressed Steel Car Co. |
| | 250 | Box | Bethlehem Steel Co. |
| | 825 | Auto-box | General American Trans. Corp. |
| | 350 | Auto-box | Mt. Vernon Car Mfg. Co. |
| Virginian | 25 | 50-ton auto-box | Greenville Steel Car Co. |
| Virginian Smelting Co. | 1 | 40-ton tank | General American Trans. Corp. |
| Western Maryland | 100 [7] | 50-ton auto-box | Bethlehem Steel Co. |
| Western Pacific | 50 | 50-ton flat | Pacific Car & Fdry. Co. |
| | 100 | 50-ton Hart selective ballast | American Car & Fdry Co. |
| | 200 | Box | Mt. Vernon Car Mfg. Co. |
| W. & L. E. | 250 | 60-ton hopper | Company shops |

## Freight-Car Inquiries

| | | | |
|---|---|---|---|
| B. & O. | 1,500 | Gondola | |
| C. & I. M. | 100 | 50-ton hopper | |
| | 100 | 70-ton gondolas | |
| Clinchfield | 800 | Hopper | |
| | 200 | 50-ton gondolas | |
| | 250 | 50-ton box | |
| Grt. Nor. | 1,000 | 50-ton box | |
| | 500 | 50-ton gondolas | |
| Ill. Central | 1,000 | 40-ft. 6-in. box | |
| | 800 | 50-ft. 6-in. box | |
| | 1,000 | 50-ton hopper | |
| | 300 | 40-ft., 40-ton refrig. | |
| Lake Superior & Ishpenning | 100-200 | 50-ton ore | |
| L. & N. | 3,000 | Hopper | |
| M-K-T | 500 | 40-ton gondolas | |
| | 100 | 40-ton auto, with loaders | |
| | 150 | 50-ton auto. | |
| | 500 | 40-ton stock | |

## Passenger-Car Orders

| Road | No. of cars | Type of car | Builder |
|---|---|---|---|
| B. & M. | 20 | Coaches | Pullman-Standard Car Mfg. Co. |
| C. & N. W. | 23 | Challenger-type coaches | Pullman-Standard Car Mfg. Co. |
| C. & O. | 10 | Horse-exp. | St. Louis Car Co. |
| G. M. & N. | 1 [8] | Power-mail bagg. | American Car & Fdry. Co. |
| | 2 [8] | Trailer coaches | |
| Pere Marquette | 10 | Bagg.-exp. | St. Louis Car Co. |
| R. F. & P. | 6 | Bagg.-express | American Car & Fdry. Co. |
| Sou. Pac.<br>C. & N. W.<br>Union Pac. | 2 trains [9] | | Pullman-Standard Car Mfg. Co. |

## Passenger-Car Inquiries

| | | | |
|---|---|---|---|
| Grt. Nor. | 12 | Coaches | |
| M-K-T | 3 | Diners | |
| | 25 | Air-conditioned chair | |
| | 1 | Lounge | |

[1] The 4-8-4 type locomotives will have 80-in. driving wheels, and the 4-6-6-4 type 84-in. driving wheels. Both types will have boilers of nickel steel construction, will be equipped with roller bearings and will burn oil. With these locomotives only one change of engine will be necessary between Chicago and the Pacific coast, the change being made at La Junta, 991 miles from Chicago and 1,236 miles from Los Angeles. The 10 freight locomotives are designed after experimental locomotives which the Santa Fe has used during the past six years in handling heavier trains over mountain territory at higher speeds.

[2] The Chicago, Burlington & Quincy, on December 23, applied to the Interstate Commerce Commission for authority to issue $7,080,000 of two per cent equipment trust certificates, to be sold in connection with the construction of this equipment at a total estimated cost of $8,861,300. The Refrigerator Express Company is a Burlington subsidiary.

[3] With 80-in. driving wheels.

[4] These locomotives will have 25-in. by 34-in. cylinders and a total weight in working order of 431,000 lb.

[5] Ordered for the road by the Rodger Ballast Car Co.

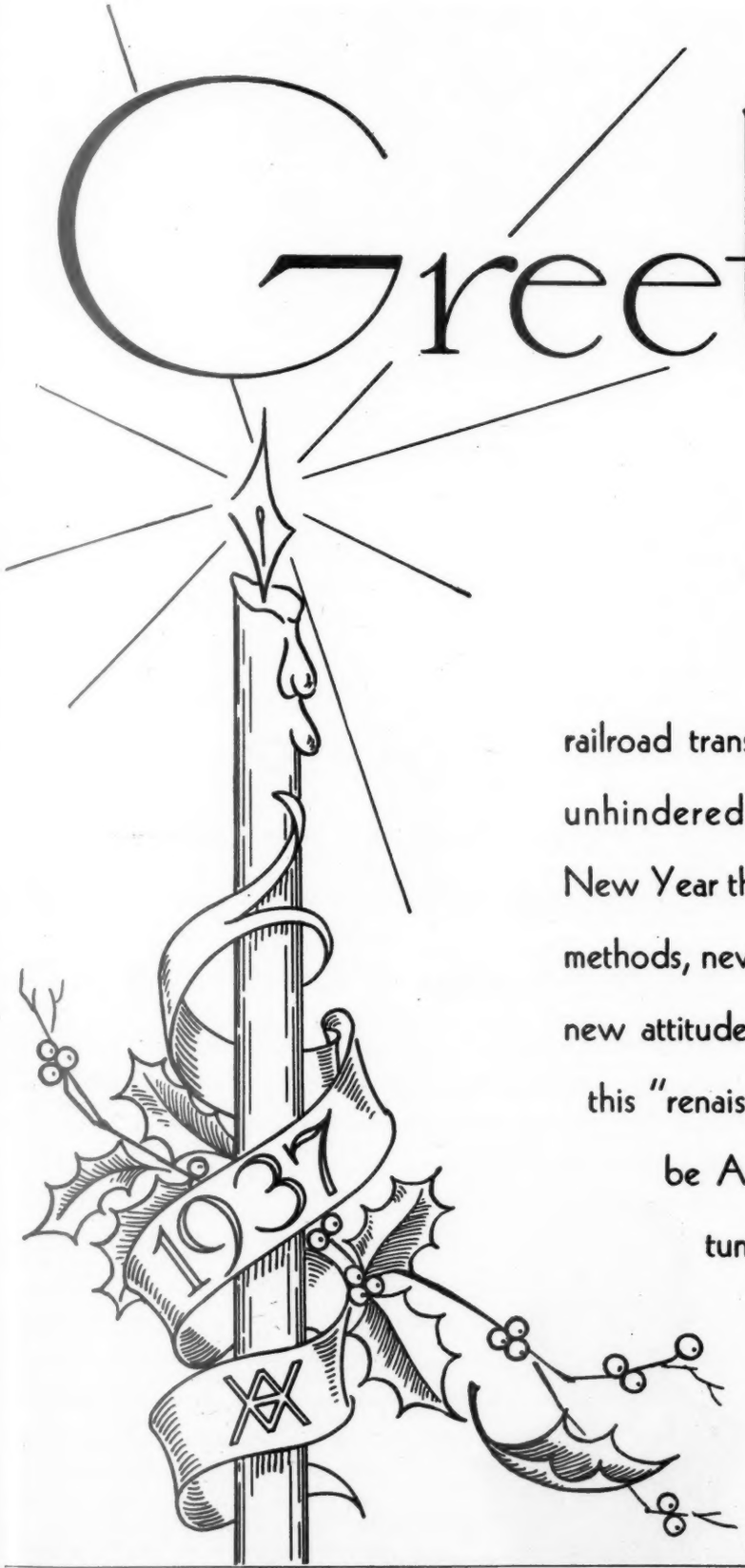
[6] The 2,000 cars will cost approximately $7,785,000. The work of rebuilding 1,750 refrigerator cars will be done in the company's shops at Roseville, Calif., and Los Angeles, at a cost of $2,715,000. The order for 2,000 new cars follows that placed last April for 2,700 cars.

[7] In addition to the 600 cars reported in the December issue.

[8] To be of light-weight streamline design.

[9] See "Equipment Building and Betterment Programs," page 46.

# Greetings




MAY the revival of railroad transportation activity continue unhindered and unabated during the New Year through the influence of new methods, new materials, new equipment, new attitudes . . . . Our contribution to this "renaissance in railroading" shall be Air Brakes that are in tune with the times.

WESTINGHOUSE AIR BRAKE CO.

GENERAL OFFICE AND WORKS « « » » WILMERDING, PENNSYLVANIA

*The St. Louis-San Francisco* has applied to the United States district court at St. Louis, Mo., for permission to spend $2,184,875 for the widening of cuts and fills, the replacement of old rails, the construction of bridges, the repair of station buildings and the repairing of locomotives. It also seeks permission to scrap 25 locomotives and 695 passenger and freight cars.

*The Missouri Pacific* on December 28 was granted permission by the Federal District Court at St. Louis to spend $8,552,302 for additions and betterments.

Included will be: $114,000 for an engine house at Atchison, Kan.; $125,870 for a 12-stall extension to the enginehouse at Kansas City, Mo.; $67,500 for a 9-stall extension to the roundhouse at Omaha, Neb.; $103,800 for improvements to the power plant at the shops at North Little Rock, Ark.; $2,671,470 for rails, fastenings and labor; $611,000 for automatic block signals, and the balance for equipment, air conditioning, modernizing cars and miscellaneous expense incident to operation of the property.

*The Chicago & North Western* on December 29, was authorized by the federal district court at Chicago to purchase $6,307,500 of new equipment as follows: $1,000,000 for eight streamlined passenger locomotives with 84-in. driving wheels, two for use on the "Four Hundred" and six for use on through trains between Chicago and Omaha; $1,385,000 for 23 "Challenger"-type coaches of which 10 will be used on the Chicago-Los Angeles "Challenger" and 13 on two new "Challengers" which will be placed in service between Chicago and San Francisco, and Chicago and Portland about June 1; $1,540,000 for 500 seventy-ton hopper cars; $2,000,000 for 500 fifty-ton automobile cars; and $382,500 for 150 seventy-ton ballast cars.

*The Norfolk & Western* will buy 1,000 hopper coal cars and 40,000 tons of 131-lb. rail and fastenings. The coal cars are in addition to the 500 gondolas and 500 hopper coal cars to be built in the company's shops at Roanoke, Va., as reported in the December issue. The total cost of this equipment and rail, including the eight 2-6-6-4 locomotives reported also in December will be about $8,000,000.

*The Western Pacific* has awarded a contract to Ryberg Brothers, Salt Lake City, Utah, for work in connection with the extension of its enginehouse at Oroville, Cal., at a cost of approximately $51,000. The work to be done under this contract involves the construction of six additional stalls in the enginehouse, which now embodies eight stalls, to accommodate locomotives having an overall length of 118 ft. the new stalls will be 140 ft. in length, or 40 ft. longer than the existing stalls. Equipment to be installed in the enginehouse addition includes a Whiting drop table and swing gates, a truck drop pit and a 100-ft. monorail hoist.

*The Southern Pacific*, the *Chicago & North Western* and the *Union Pacific* have placed an order with the Pullman-Standard Car Manufacturing Company for two lightweight, streamline trains. These trains, the largest built thus far, for service between Chicago and San Francisco and Los Angeles, will replace the present City of Los Angeles and City of San Francisco, which will be transferred to other service. The Diesel-electric locomotives, of 5,400 hp. capacity each, will be built by the Electro-Motive Corporation. Each train will consist of 14 cars, with a total length, including the locomotive, of 1,250 ft. The three-unit locomotive will be 208 ft. 8 in. in length, and each unit will have two 900-hp. Diesel-electric power plants. The first car will house the auxiliary Diesel-generator sets used for air conditioning and train lighting. In the Pullman equipment there will be a duplex bedroom car on each train, while other Pullman accommodations will include sections, compartments, drawing rooms and individual and double bedrooms. The berths on all cars will be wider and longer than those on conventional equipment. Each train will have two dining cars; one on each train will be of the coffee shop type for service of popular priced meals. The total capacity of the City of San Francisco will be 228, with 174 Pullman passengers and 54 coach passengers. The City of Los Angeles will have Pullman accommodations for 150 passengers and 104 coach passengers, a total of 254.

# Supply Trade Notes

J. E. MAHONEY, representative of the P. & M. Company, Chicago, has been promoted to Chicago district sales agent.

WALTER D. SNYDER has been appointed eastern sales representative of the Ajax Manufacturing Company, Cleveland, Ohio.

ALBERT E. HILL, service engineer of Standard Equipments, Inc., with headquarters in New York, has been appointed western manager in charge of sales and engineering, with headquarters at Chicago.

THE CORBETT CORPORATION, Sawyer and Winter streets, Houston, Texas, has been appointed Texas sales representatives for the Globe Steel Tubes Company, 3839 W. Burnham street, Milwaukee, Wis.

N. M. LOWER, who has been associated for several years with the Standard Stoker Company, Inc., at its New York office, has been appointed works manager of the company, with headquarters at Erie, Pa.

THE EDWARD G. BUDD MANUFACTURING COMPANY, railway division, has opened a mid-western sales and service office in the Railway Exchange building, Chicago. Thomas H. Henkle, western sales manager, is in charge of the office.

C. E. MURPHY, 415 Midland building, Cleveland, Ohio, has been appointed representative in that region of the Graham-White Sander Corporation, Roanoke, Va., and W. P. Thomas, 4155 Garfield avenue, Minneapolis, Minn., has been appointed representative for the Minneapolis and St. Paul region. Mr. Thomas was formerly road foreman of engines on the Minneapolis & St. Louis and was service engineer of the Franklin Railway Supply Company.

GEORGE B. CHRISTIAN, formerly sales engineer, western territory, for the Wine Railway Appliance Company, Toledo, Ohio, has been appointed assistant general sales manager, and Cleon M. Hannaford has been appointed sales engineer, western territory, both with headquarters at Toledo.

HERMAN H. LIND has been appointed executive vice-president of the American Institute of Bolt, Nut and Rivet Manufacturers, with headquarters in the Guardian building, Cleveland, Ohio. For 17 years Mr. Lind was engaged in accounting, engineering, production and sales work in the manufacturing field. From 1923 to 1930 he was active in consulting and negotiating work for various manufacturers. In the latter year he became general manager of the Malleable Iron Research Institute, and from July, 1932, through 1936 was general manager of the National Machine Tool Builders' Association.

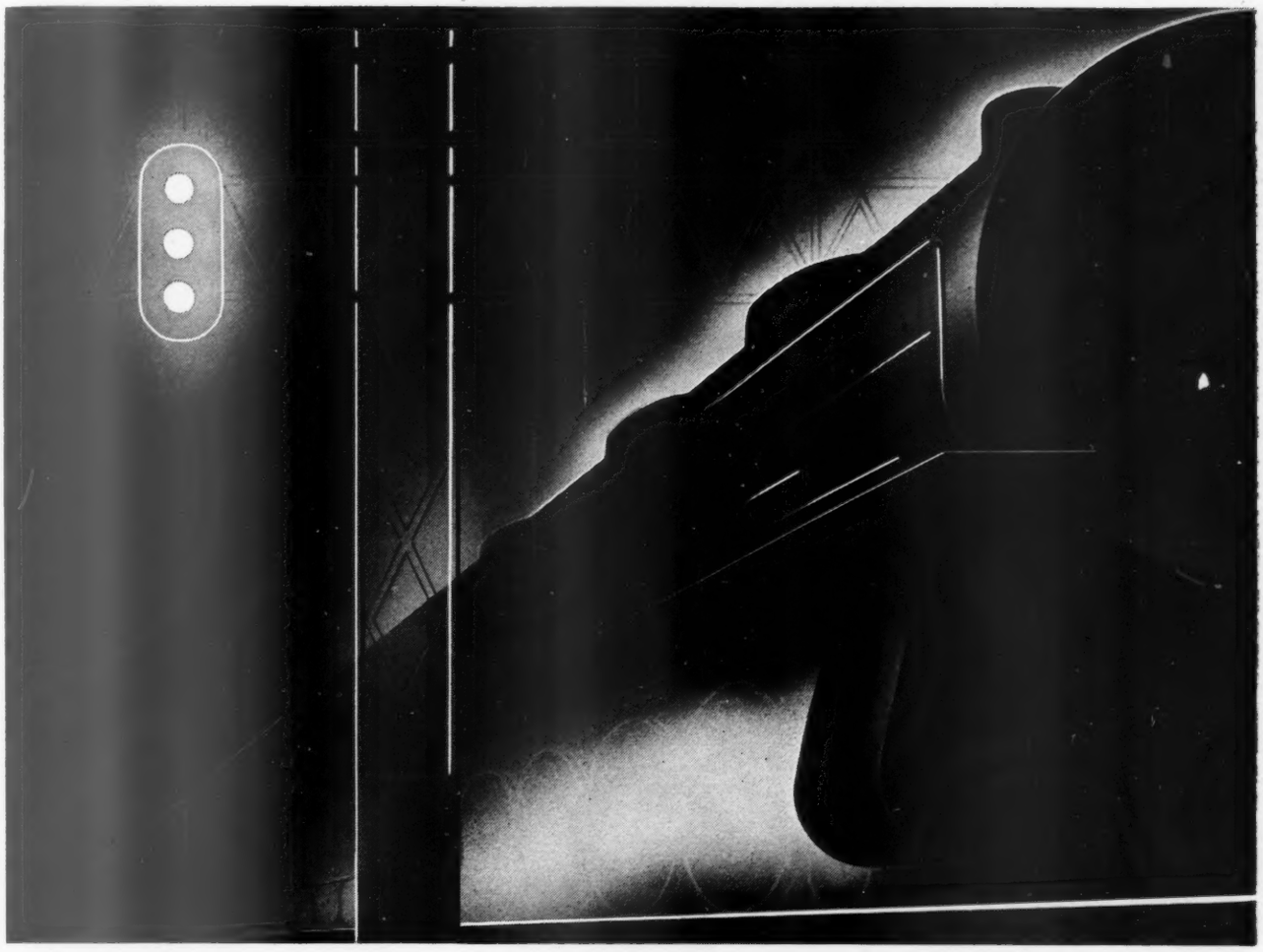
**Herman H. Lind**

THE AMERICAN ROLLING MILL COMPANY, Middletown, Ohio, has started work on a new modern research laboratory at Middletown, to cost $260,000. The Austin Company are the contractors. The laboratory will replace the building destroyed by an explosion in December, 1935.

THOMAS H. WILBER has been appointed general manager of the Bullard-Dunn Process Division of the Bullard Company, Bridgeport, Conn. This division engineers and licenses the use of the Bullard-Dunn electro-chemical process for the descaling of metals. Thomas E. Dunn, Jr., has also been appointed to the sales department of the division. His headquarters will be at 309 Miller-Storm building, 12015 Linwood avenue, Detroit, Mich.

B. C. WILKERSON has been appointed chief eastern service engineer of the Superheater Company, 60 East Forty-Second street, New York, and Frank W. Smith has been appointed service engineer, servicing Elesco equipment on New England railroads. The headquarters of both men will be at New York. Mr. Wilkerson until recently serviced Elesco equipment in the New England territory. Mr. Smith

*(Continued on next left-hand page)*



# More speed—more need for MOLY steels

Faster and faster freight and passenger schedules! Greater stresses on equipment! New problems in safety! Moly steels are proving an important factor, not only in making rolling stock stronger and safer, but in making it lighter . . . reducing the dead load and enabling increase in pay loads.

That isn't all . . . Moly steels save money on construction costs. They actually cost less than other alloy steels having equivalent properties for a given purpose. They cast, forge, weld, machine, heat-treat better—saving time and material and reducing rejects to the minimum.

Moly steels last longer, even where corrosion is a factor . . . reducing maintenance and depreciation costs. The added cost for Moly steel wheels is usually more than justified. Car frames and bodies are lighter, stronger, more durable. On a train-mile or any other basis, Moly steels will make a notable reduction on over-all operating costs.

Purchasing, engineering and production heads will find unusual interest in our technical book, "Molybdenum." Free for the asking—as is also "The Moly Matrix," our monthly news-sheet. Climax Molybdenum Company, 500 Fifth Avenue, New York.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

Climax Mo-lyb-den-um Company

MOLY

started his career as an engineering apprentice in the employ of the American Locomotive Company at Schenectady, N. Y. He then had four years of practical railroad experience with the Union Pacific at Omaha, Neb. With the exception of two years in the U. S. Army Engineers during the World War, Mr. Smith has since been in the engineering department of the Superheater Company.

TELL BERNA has been appointed general manager of the National Machine Tool Builders' Association, 10525 Carnegie avenue, Cleveland, Ohio, succeeding Herman H. Lind who is now executive vice-president of the American Institute of Bolt, Nut and Rivet Manufacturers. Mr. Berna is a graduate of Cornell University, where he received the degree of mechanical engineer. For the past six years he has

**Tell Berna**

been general sales manager of the National Acme Company of Cleveland. Prior thereto he was successively sales manager of the Union Twist Drill Company, Athol, Mass.; the G. A. Gray Company, Cincinnati, Ohio, and manager of the Cincinnati, Ohio, office of Cutler-Hammer.

GEORGE W. BENDER has been appointed sales representative of the Equipment Specialties Division of the Union Asbestos & Rubber Company, Chicago, with headquarters at St. Paul, Minn., and the Howat Equipment Company, Grant building, Pittsburgh, Pa., has been appointed sales representative in Pittsburgh and other eastern territory.

M. C. BLEST, chief engineer of the Pressed Steel Car Company, Inc., Pittsburgh, Pa., has been appointed consulting engineer, and J. P. Anderson, assistant chief engineer, succeeds Mr. Blest as chief engineer. Mr. Blest has been associated with the Pressed Steel Car Company since 1901, prior to which time he spent 12 years with the Harlan & Hollingsworth Company of Wilmington, Del. (now part of the Bethlehem Steel Company), where he served in various capacities in the passenger car and ship building departments. He first served with the Pressed Steel Car Company as draftsman, in 1901, and subsequently as chief draftsman and in June, 1912, was appointed mechanical engineer of the Western Steel Car & Foundry Company (subsidiary of the Pressed Steel Car Company), at Hegewisch, Ill. He went to McKees Rocks plant of the Pressed Steel Car Company in 1915 as mechanical engineer and since 1923 has served as chief engineer.

J. P. Anderson entered the employ of the Pressed Steel Car Company as a draftsman in May, 1904, and subsequently served as assistant chief draftsman and chief draftsman until October, 1919. He was then transferred to Buenos Aires, South America, as sales engineer, returning in July, 1922, and was appointed assistant mechanical engineer. The following year he was transferred to the Koppel Industrial Car & Equipment Company (subsidiary of the Pressed Steel Car Company) as assistant chief engineer and in February, 1936, returned to the Pressed Steel Car Company, at McKees Rocks, as assistant chief engineer.

C. F. CHRISTOPHER, open-hearth superintendent of the Railway Steel-Spring Division, American Locomotive Company, has been promoted also to the position of chief metallurgist, made vacant by the death of Paul J. Neely. Mr. Christopher, from 1923 to 1928, was with the Jones & Laughlin Steel Corporation, serving in various positions until he finally became assistant superintendent of one of the open-

**C. F. Christopher**

hearth departments. He subsequently to 1934 was employed by the U. S. Bureau of Mines, Carnegie Institute of Technology and Metallurgical Advisory Board and then entered the employ of the Railway Steel-Spring Division, American Locomotive Company as open-hearth superintendent.

THE SAFETY CAR HEATING & LIGHTING CO., New York, and the Spicer Manufacturing Company, Toledo, Ohio, have made an arrangement under which, hereafter, in addition to the direct gear drive now manufactured and sold by the Spicer Manufacturing Company, that company will also manufacture the Safety Car Heating & Lighting Co.'s Vee belt and gear drive for railway car generators. The Safety Car Heating & Lighting Co. will hereafter market both types of drives. This arrangement has been worked out in order to take advantage of the specialized manufacturing facilities of the Spicer Manufacturing Company, and to avoid the duplication of the Safety Car Heating & Lighting Co.'s existing nation-wide sales and servicing organization.

GEORGE H. WEILER has become associated with the Vanadium Corporation of America as manager, Eastern Railroad division, with headquarters in New York

**George H. Weiler**

City. For a number of years Mr. Weiler was sales manager of the American Locomotive Company, New York; later secretary-manager of the Forging Manufacturers' Association, New York City, and more recently was connected with the Standard Steel Works Company, Burnham, Pa.

THE TIMKEN ROLLER BEARING COMPANY, Canton, Ohio, has announced the following changes in its organization: Frederick J. Griffiths resigned as a director and as president and director of its wholly-owned subsidiary, the Timken Steel & Tube Company. William E. Umstattd, president of the parent company, has been elected also president of the subsidiary, and H. H. Timken, Jr., previously a vice-president of the Timken Steel & Tube Company, has become its executive vice-president, in addition to his capacity as vice-president and director of the Timken Roller Bearing Company. W. Robert Timken has been elected director of both companies to fill Mr. Griffiths' unexpired terms, and John E. Fick has been appointed general superintendent of the steel and tube mills, succeeding K. B. Bowman, resigned.

## Obituary

PAUL J. NEELY, chief metallurgist, Railway Steel-Spring Division, American Locomotive Company, died at Latrobe, Pa., on December 10. Mr. Neely entered the employ of the Latrobe plant in 1903 in the chemical laboratory, and constantly advanced until he became chief metallurgist.

CHARLES W. OSBORNE, chairman of the board of directors of the Gold Car Heating & Lighting Company, Brooklyn, N. Y., died on December 1, at his home in Englewood, N. J. Mr. Osborne celebrated his 97th birthday last August and up to this time has been active as a member of the board. He had been with the company since March, 1888, over 48 years ago.

*(Turn to next left-hand page)*

# YOU'LL GET YOUR MONEY'S WORTH

## During the Winter Months

## IF YOUR TRAINS ARE EQUIPPED WITH BARCO *Steam Heat* CONNECTIONS

LOWER cost for heating cars—lower maintenance cost—satisfied passengers—infrequent repairs—that's why many railroads specify BARCO Metallic Car Steam Heat Connections.

A BARCO connection installed now insures trouble-free service for the winter and eliminates those troubles that usually occur when your men are the busiest.

BARCO

*flange type metallic*
STEAM HEAT CONNECTIONS

BARCO MANUFACTURING COMPANY
1811 W. WINNEMAC AVENUE, CHICAGO, ILLINOIS

THE HOLDEN CO., LTD.
In Canada
Montreal — Moncton — Toronto — Winnipeg — Vancouver

# Personal Mention

## General

H. W. Reynolds, mechanical inspector of the Norfolk & Western at Roanoke, Va., has been promoted to the position of assistant mechanical engineer.

M. L. Carlson has been appointed superintendent of motive power of the Missouri & Arkansas, with headquarters at Harrison, Ark., to succeed E. A. Shull, who has resigned.

R. M. Pilcher, assistant engineer of tests of the Norfolk & Western, has been promoted to the position of mechanical inspector, with headquarters at Roanoke, Va., to succeed H. W. Reynolds.

Charles A. Gill, superintendent of motive power and rolling equipment of the Reading and the Central of New Jersey at Reading, Pa., has been appointed general manager of these companies, with headquarters at Reading.

E. J. McSweeney, district master mechanic of the Western lines of the Baltimore & Ohio, has been appointed superintendent of motive power of the Western lines, with headquarters as before at Cincinnati, succeeding G. R. Galloway.

M. R. Reed, general superintendent of motive power of the Central Region of the Pennsylvania at Pittsburgh, Pa., has been appointed superintendent of motive power of the Eastern Pennsylvania division.

Thomas W. Demarest, general superintendent of motive power of the Western region of the Pennsylvania, with headquarters at Chicago, Ill., has been assigned to duty on the staff of the chief of motive power at Philadelphia, Pa.

W. Y. Cherry, general superintendent of motive power of the New York zone of the Pennsylvania at New York, has been appointed general superintendent of motive power of the Western region, with headquarters at Chicago, succeeding T. W. Demarest.

G. R. Galloway, superintendent of motive power of the Western lines of the Baltimore & Ohio, with headquarters at Cincinnati, Ohio, has been appointed superintendent of motive power of the Eastern lines, with headquarters at Baltimore, Md., succeeding A. K. Galloway.

E. L. Bachman, master mechanic of the Philadelphia division of the Pennsylvania at Harrisburg, Pa., has been appointed general superintendent of motive power of the New York zone, with headquarters at New York, succeeding W. Y. Cherry.

A. K. Galloway, superintendent of motive power of the Eastern lines of the Baltimore & Ohio, with headquarters at Baltimore, Md., has been appointed superintendent of motive power and rolling equipment of the Reading and the Central of New Jersey, with headquarters at Reading, Pa., succeeding C. A. Gill.

H. H. Haupt, superintendent of motive power of the Eastern and Central Pennsylvania divisions of the Pennsylvania, has been appointed general superintendent of motive power of the Central region, with headquarters at Pittsburgh, Pa., succeeding M. R. Reed.

## Master Mechanics and Road Foreman

John B. Halliday, shop superintendent of the Pere Marquette at Wyoming, Mich., has been appointed master mechanic of the Canadian division, with headquarters at St. Thomas, Ont., succeeding Elmer A. Kuhn.

W. F. Harris, general foreman locomotive department of the Western lines of the Baltimore & Ohio at Willard, Ohio, has been appointed master mechanic, with headquarters at Akron, Ohio.

E. M. Caffray, road foreman of engines of the Western Pacific at Oroville, Cal., has been appointed acting master mechanic, with headquarters at the Sacramento (Cal.) shops, to succeed M. T. Saunders, master mechanic, who has been granted a leave of absence.

J. S. Bell, assistant enginehouse foreman of the Pennsylvania at Philadelphia, Pa., has been appointed assistant master mechanic of the Columbus, Cincinnati and Toledo divisions, with headquarters at Columbus, Ohio.

John Dunlevy Davenport, who has been appointed master mechanic of the Chesapeake & Ohio at Hinton, W. Va., as noted in the November issue of the *Railway Mechanical Engineer*, was born on October 22, 1885, at Richmond, Va. He received a high-school education and entered the service of the Chesapeake &

J. D. Davenport

Ohio in September, 1902, as a machinist apprentice at Richmond. Upon the completion of his apprenticeship in 1906 he was employed as a machinist until November, 1910, when he was promoted to the position of machine shop foreman. From 1911 until 1920 he was erecting shop foreman at Richmond, during the latter part of this period being employed as inspector for the C. & O. at Schenectady, N. Y., and also as chief locomotive inspector for the Railroad Administration at Pittsburgh, Pa. He became general foreman at the Seventeenth street shops of the C. & O. at Richmond in January, 1920, being transferred to the position of general foreman at Charlottesville, Va., in November of the same year. He became assistant master mechanic of the Fulton shops at Richmond on August 1, 1926, and on February 1, 1932, was transferred back to Charlottesville as general foreman. He was appointed assistant master mechanic at Hinton on July 1, 1933, and master mechanic on October 1, 1936.

## Obituary

Robert A. Reid, master mechanic of the Toledo-Ludington division of the Pere Marquette, at Saginaw, Mich., died on Thursday, December 10, at the age of 61. Mr. Reid began his 44 years of service with the Pere Marquette in 1892 as a ma-

R. A. Reid

chinist apprentice. Several years later he became night enginehouse foreman and in 1909 was promoted to the position of general enginehouse foreman. In 1917 he became general foreman of the machine shop at Saginaw and two years later was promoted to shop superintendent. A year later he became assistant master mechanic and in 1923, master mechanic.

William Cunningham, chief interchange inspector of the Detroit Car Interchange Inspection Association, died on November 5, 1936. Mr. Cunningham was born on May 8, 1865. He entered the maintenance of way department of the Michigan Central at Dexter, Mich., at the age of nineteen, and the following year entered car department service at Lansing, Mich. He was subsequently moved to Detroit, Mich., in charge of the car department, and later was placed in charge of the car department at Jackson, Mich. Early in the 1900's he returned to Detroit to take charge of passenger-car work. On September 5, 1910, he was placed in charge of the freight car department of the Pere Marquette at Detroit, and on September 16, 1915, was chosen for the position of chief interchange inspector of the Detroit Car Interchange Inspection Association.